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AN ANALYSIS OF INJURY AT THE MARINE CORPS SCHOOL OF INFANTRY (SOI)

by

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Recent policy changes to the Marine Corps regarding gender integration into combat arms occupation fields affect the methods that these occupations traditionally use for training. Recent studies since the start of the gender integration indicate that differences may exist between male and female graduation rates at the Marine Corps' primary infantry training school, the School of Infantry (SOI). I analyze whether differences in dropping due to injury exist between genders at the Marine Combat Training (MCT) and Infantry Training Battalion (ITB) courses. I proposed investigating whether injury rates differ between genders or between the two SOI school locations, Camp Pendleton, California, and Camp Geiger, North Carolina. I analyze whether the recently implemented Initial Strength Test (IST) serves as a predictor for injury in initial infantry training. Lastly, I analyze whether those who attrite from initial infantry training due to injury earn different performance marks than those who graduate the training without dropping for injury. Due to data limitations, I limit my analysis to SOI-East. I find that injury drop differences exist between genders; I am unable to compare differences between training locations. Negative correlations exist between dropping for injury and average performance marks. Lastly, IST scores, on average, fail to predict injury drop; however, certain events serve as predictors for female candidates.

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AN ANALYSIS OF INJURY AT THE MARINE CORPS SCHOOL OF INFANTRY (SOI)

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Submitted in partial fulfillment of the
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ABSTRACT

Recent policy changes to the Marine Corps regarding gender integration into combat arms occupation fields affect the methods that these occupations traditionally use for training. Recent studies since the start of the gender integration indicate that differences may exist between male and female graduation rates at the Marine Corps' primary infantry training school, the School of Infantry (SOI). I analyze whether differences in dropping due to injury exist between genders at the Marine Combat Training (MCT) and Infantry Training Battalion (ITB) courses. I proposed investigating whether injury rates differ between genders or between the two SOI school locations, Camp Pendleton, California, and Camp Geiger, North Carolina. I analyze whether the recently implemented Initial Strength Test (IST) serves as a predictor for injury in initial infantry training. Lastly, I analyze whether those who attrite from initial infantry training due to injury earn different performance marks than those who graduate the training without dropping for injury. Due to data limitations, I limit my analysis to SOI-East. I find that injury drop differences exist between genders; I am unable to compare differences between training locations. Negative correlations exist between dropping for injury and average performance marks. Lastly, IST scores, on average, fail to predict injury drop; however, certain events serve as predictors for female candidates.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACL	Anterior Cruciate Ligament
AFQT	Armed Forces Qualification Test
BRC	Basic Reconnaissance Course
CFT	Combat Fitness Test
DGCDAR	Direct Ground Combat Definition and Assignment Rule
DoD	Department of Defense
FMF	Fleet Marine Forces
GCA-IST	Ground Combat Arms-Initial Strength Test
GCE	Ground Combat Element
GCEITF	Ground Combat Element – Integrated Task Force
IOC	Infantry Officers Course
IQ	Intelligence Quotient
ITB	Infantry Training Battalion
MCFIP	Marine Corps Female Integration Plan
MCT	Marine Combat Training
MOS	Military Occupation Specialty
NCAA	National Collegiate Athletic Association
PFT	Physical Fitness Test
SOI	School of Infantry
TBI	Traumatic Brain Injury
TFDW	Total Force Data Warehouse
USMC	United States Marine Corps

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EXECUTIVE SUMMARY

A. OVERVIEW

The Marine Corps centers its organizational capabilities on the infantry. Because the infantry depends almost entirely on personnel, investing in the training of these people comprises a significant portion of its budget. Therefore, any significant attrition within infantry training warrants investigation. My research investigates the attrition due to injury at the Marine Corps' School of Infantry (SOI), specifically the Infantry Training Battalion (ITB) and Marine Combat Training (MCT) units. These two units provide training of infantry skills to all enlisted Marines following graduation from recruit training, more commonly known as boot camp. My analysis indicates that men and women differ in probability of attriting due to injury at SOI. I find that physical fitness scores correlate to the probability that a Marine will drop due to injury.

Recently, attrition rates at ITB and SOI raise interest. Captain Viviana Lee states in her 2018 research of ITB that the average civilian male is 5.2 more likely to graduate ITB than the average civilian female (Lee, 2018). This statement alone raises doubt to whether current infantry training efficiently supports the investments of the Marine Corps in human capital, especially under the Marine Corps Female Integration Plan published in 2013, allowing females to serve in combat arms occupations to include the infantry. In 2013, the Commandant of the Marine Corps published a plan to test and analyze the feasibility of women to serve in all combat arms occupations to find the most favorable options for implementation. After experimentation and analysis, the Marine Corps began implementation as outlined in Fragmentary Order 4, Marine Corps Female Integration Plan (MCFIP) (Department of Defense [DoD], 2015).

B. RESEARCH QUESTIONS

Since the Marine Corps policy changes, requests for detailed analysis of attrition from SOI populated. I examine the extent to which attrition due to injury at the School of Infantry differs between genders; to what extent does attrition due to injury differ between SOI-East (Camp Geiger, North Carolina) and SOI-West (Camp Pendleton, California)? I find that women are more likely to drop due to injury at SOI than men. Due to gaps in my data, I am unable to properly analyze the difference between SOI-East and SOI-West, but find through aggregate data at the Navy EpiData center that ITB at SOI-West sustains more reported lower leg and ankle injuries than SOI-East (EpiData Center, 2019). My secondary research question contains two parts and determines if a correlation exists between attrition due to injury at SOI and performance at future units. Secondly, I analyze whether the scores received on the Ground Combat Arms–Initial Strength Test (GCA-IST) when recruited serve as predictors for injury at SOI. I find that dropping due to injury negatively correlates to average performance marks for a Marine's time in service. The GCA-IST events, run time and crunches, correlate to the probability of dropping due to injury for females and males, but female scores more strongly correlate to injury drop than male scores.

C. PURPOSE OF STUDY

The results of my research aid future policies related to recruiting, gender integration, training requirements, and retention among many unforeseeable policy decisions. Through understanding the difference in injuries between males and females, appropriate physical standards can develop to achieve the Marine Corps goal of 10% of the force comprised of women. By understanding the difference in injury rates between SOI-East and SOI-West, further research can narrow the scope to reveal more specific reasons for injury. My secondary questions reveal information primed for recruiting policy; by understanding how well GCA-IST scores predict injury and whether injury predicts future positive or negative performance, better measurable qualities for recruits develop and likely contribute to less attrition due to injury.

Gender integration in the military has developed in congressional policies since World War II. Major changes to the social policy came in 1994 and then again in 2013 with the rescinding of the Direct Ground Combat Definition and Assignment Rule (DGCDAR) from 1994 (DoD, 1998; Vergun, 2013). Throughout these policy revisions, various studies have shown differences in injury rates between males and females. A 2000 research article finds through systematic review of previous studies that a significant difference exists between male and female musculoskeletal injury rates in military training

(Kaufman, Brodine, & Shaffer, 2000). The same year, a research team followed army trainees through basic training. The research team finds that women had a relative risk of injury of 2.1 when compared to men (Bell, Mangione, Hemenway, Amoroso, & Jones, 2000). These past studies indicate that men and women sustain injuries differently in military training.

Location of training also lacks significant credible research as related to injury rates. This lack of information leaves the cultural or climate difference effects on injury rates between SOI-East and SOI-West up to speculation without further research. From my experience as a Marine Infantry Officer, indications show different cultures exist between East and West infantry units warranting investigation into how this affects attrition due to injury.

D. DATA

The data for my research comes from the Marine Corps' Total Force Data Warehouse (TFDW), the SOI-East Sports Trainer's office, and aggregate data regarding injury rates from the Navy EpiData Center. It includes data from 2012–2018; this gives the data 3 years leading to gender integration policy and three years after.

Upon review and cleaning, I limit my sample to Marines between the grades of E1-E3 to target those attending ITB and MCT. I determine that 59,333 observations lack sufficient data for analysis. I exclude these observations as well as observations from SOI-West because SOI-West did not receive its first female Marine students until 2018 and I want to maintain analysis on gender integrated training without biasing the results due to the high number of males at SOI-West.

To develop an independent variable, I use merged data from TFDW and the SOI-East sports trainer and determine from these datasets whether a Marine at SOI-East ever dropped due to injury. I name this indicator variable INJURY_DROP.

My analysis suffers bias throughout due to the administrative errors described and bias due to specific variable use within TFDW. I explain these problems in detail in the body of my thesis.

E. ANALYSIS

From the described data provided to me, I use simple regression analysis to find correlations between injury and gender, injury and training location, injury and GCA-IST, and performance marks (Proficiency and Conduct marks 1 year after SOI) and injury. I develop the following models to answer my research questions:

- $\Pr(\text{INJURY\_DROP}) = B0 + B1 * \text{FEMALE} + B2 * \text{PFT\_SCORE} + B3 * \text{CFT\_SCORE} + B4 * \text{GT\_SCORE} + B5 * \text{Race} + B6 * \text{Family Status} + \varepsilon$

- $\Pr(\text{INJURY\_DROP}) = B0 + B1 * \text{FEMALE} + B2 * \text{AFTER\_POLICY} + B3 * \text{FEMALE} * \text{AFTER\_POLICY} + B4 * \text{PFT\_SCORE} + B5 * \text{CFT\_SCORE} + B6 * \text{GT\_SCORE} + B7 * \text{Race} + B8 * \text{Family Status} + \varepsilon$

- $\Pr(\text{INJURY\_DROP}) = B0 + B1 * \text{FEMALE} + B2 * \text{AFTER\_POLICY} + B3 * \text{FEMALE} * \text{AFTER\_POLICY} + B4 * \text{FEMALE} * \text{PFT\_SCORE} + B5 * \text{FEMALE} * \text{CFT\_SCORE} + B_6 * \text{PFT\_SCORE} + B7 * \text{CFT\_SCORE} + B8 * \text{GT\_SCORE} + B9 * \text{Race} + B10 * \text{Family Status} + \varepsilon$

- $\Pr(\text{INJURY\_DROP}) = B0 + B1 * \text{FEMALE} + B2 * \text{IST\_CRUNCH} + B3 * \text{FEMALE} * \text{IST\_CRUNCH} + B4 * \text{GT\_SCORE} + B5 * \text{Race} + \varepsilon$

- $\Pr(\text{INJURY\_DROP}) = B0 + B1 * \text{FEMALE} + B2 * \text{IST\_RUN} + B3 * \text{FEMALE} * \text{IST\_RUN} + B4 * \text{GT\_SCORE} + B5 * \text{Race} + \varepsilon$

I use logistic regression to yield results in terms of the probability of dropping due to injury. I also analyze the marginal effects of my regressions to determine the effects of specific variables including AFTER_POLICY, PFT_SCORE, CFT_SCORE, IST_CRUNCH, and IST_RUN. AFTER_POLICY serves as an indicator for whether a Marine attended SOI before or after the 2016 gender integration policy change and the other variables indicate scores achieved on the Marine's PFT, CFT, and IST.

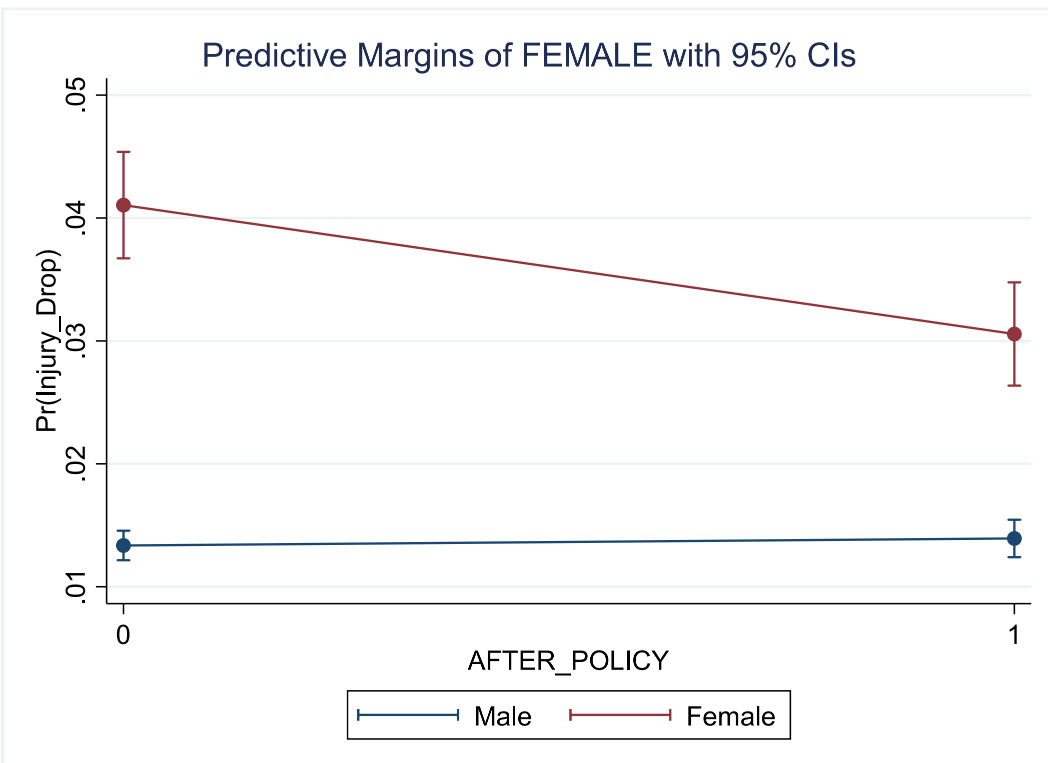
- $\text{PRO\_CON\_AVG} = B0 + B1 * \text{INJURY\_DROP} + B2 * \text{PFT\_SCORE} + B3 * \text{CFT\_SCORE} + B4 * \text{GT\_SCORE} + \varepsilon$

When analyzing the effect dropping due to injury at SOI-East has on average performance marks in the future, I use the depicted model in an OLS regression.

F. RESULTS

After analyzing gender differences, I find that female Marines at SOI-East are 2.73 times more likely to drop due to injury when holding all other factors constant. I find that physical fitness, PFT, CFT, IST crunches, and IST run time, negatively correlates to probability of dropping due to injury for women, but has little effects for men. Comparing effects before and after the gender integration policy change, I find that women after the policy are less likely to drop due to injury compared to women before the policy. I find that men are more likely to drop due to injury after the policy compared to before but this magnitude is minimal and lacks statistical significance as shown in Figure ES-1.

Figure ES-1. Logistic Regression Marginal Effects of Policy Change by Gender



After analyzing the predictive power that the IST crunch and run events have on the probability of dropping due to injury at SOI-East, I find that men see little effect from performing exceptional or poorly on either event holding all else constant. Women's probability of dropping due to injury drops significantly as their performance on these tests increases with all other factors held constant. At certain scores, female probability of dropping due to injury falls below the male probability.

My analysis of performance related to injury dropping skewed because I received the performance measure, proficiency and conduct marks, as an average across each Marine's time in service. This time is not equal for all observations. With this in mind, I find that dropping due to injury at SOI-East correlates to a 0.12 point decrease in average proficiency and conduct marks, holding all other factors constant.

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I. INTRODUCTION

A. OVERVIEW

Since its inception, the Marine Corps' Ground Combat Element (GCE) remains the only element of the Navy and Marine Corps team capable of seizing and holding enemy territory (United States Marine Corps [USMC], 2017). Today, the Marine Corps still centers all of its deployment responsibilities around the GCE, and within that, the infantry. Because of the infantry's focal importance to Marine strategy and operations, its initial training must provide Marines operating in the Fleet Marine Forces (FMF) quality yet challenging training while minimizing attrition to meet the manpower needs of the force.

Recent changes to demographic limitations across the U.S. military now allow women to serve in all Mission Occupational Specialties (MOS) available in the Department of Defense (DoD). This triggered the Marine Corps to establish the Force Integration Implementation Plan in 2016 to explain how women would integrate into the ground combat arms MOSs (Keenan, 2016). More than two years have passed since the release of the Force Integration Implementation Plan during which the United States unemployment rate dropped and attrition rates during initial infantry training at the School of Infantry (SOI) rose as a concern (Bureau of Labor Statistics [BLS], 2018; Dove & Richmond, 2017).

With changes to gender barriers and struggles to meet recruiting requirements, the attrition rates at SOI and similar infantry training schools concern the Marine Corps and its stakeholders. Various reasons contribute to the attrition at formal MOS schools and countless individual attributes affect the reasons for attrition. This study focuses on attrition due to injury at SOI. I examine to what extent differences exist in attrition due to injury based on gender and geographical area of training.

B. PURPOSE OF STUDY

The purpose of this study is to examine the extent to which injuries result in attrition from the School of Infantry's Infantry Training Battalion (ITB) and Marine Combat Training (MCT) courses. This research quantitatively analyzes injury rates based on gender as well as training location (Camp Pendleton [SOI-West] or Camp Geiger [SOI-East]). The analysis uses data that includes Marines attending ITB and MCT from 2012–2018 compiled from the Marine Corps Total Force Data Warehouse (TFDW), SOI-East Sports Trainer Injury data, and aggregate statistics from the Navy's EpiData Center. Using ordinarily least squares and logistic regression, I analyze the extent differences to which genders drop from the courses due to injury as well as differences in injury drops between SOI-East and SOI-West. By finding the extent to which injury rates differ by gender and training location, I hope to provide Marine Corps decision-makers with better insight for future policy development.

C. RESEARCH QUESTIONS

(1) Primary

To what extent does attrition due to injury at the School of Infantry differ between genders? Is there a difference and to what extent do injury rates differ between SOI East and West locations?

I find that women exhibit a higher probability of dropping due to injury than men when all other factors are held constant. Analyzing aggregate data, I find that MCT at both SOI East and West experience similar reported injuries; however, ITB SOI-West experiences higher rates of reported lower leg and ankle injuries.

(2) Secondary

Does injury attrition at SOI predict performance at future units and how strong is this correlation? Do Ground Combat Arms–Initial Strength Test (GCA-IST) scores predict injury drop at SOI and if so, how well?

My analysis indicates that those who drop due to injury at SOI receive lower average proficiency and conduct marks for their time in service, holding all else constant. I find that the GCA-IST run and crunch event scores correlate to probability of dropping due to injury for both genders, but more strongly predicts female injury drops.

D. SCOPE AND LIMITATIONS

The data for this research includes all Marines assigned to the School of Infantry from fiscal year 2012–2018 between the ranks of E1-E3. The data cannot distinguish between ITB and MCT, so this analysis subjects itself to bias as most Marines attending MCT and ITB fall in the ranks of E1 or E2. I include the rank E3 to account for Marines who extended at these courses for various reasons; including these observations likely means that Marines attending advanced courses that follow MCT or ITB are included in the analysis.

E. OVERVIEW OF CHAPTERS

The following chapters detail the thought process and methods used to arrive at my findings. Chapter II details the changes in military policy pertaining to gender as well as differences in climate and weather patterns between SOI-East and SOI-West. Chapter III also details previous research and literature related to gender differences in injury as well as differences injuries among different weather. Chapter IV details data received from TFDW, SOI-East, and the EpiData Center, and the methods for developing OLS and logistic regression models for analysis. Chapter V discusses the findings and interpretations of the analysis. Chapter VI includes summarized interpretations as well as recommendations for future research and data management.

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II. BACKGROUND

A. THE MARINE CORPS INFANTRY

The Marine Corps' mission statement reads: "As America's expeditionary force in readiness since 1775, the Marines are forward deployed to win our nation's battles swiftly and aggressively in times of crisis. We fight on land, sea and air, as well as provide forces and detachments to naval ships and ground operations" (USMC, 2018). This mission statement encapsulates the reasoning for the current organization of the Marine Corps. Since its inception, the Marines have provided a ground fighting military force capable of employment from the sea. As time passed, the Corps diversified its personnel in various occupational fields such as supply, logistics, or aviation for supporting those specialized in combat operations. Today, many occupational fields, known as Military Occupational Specialties (MOS), exist, but all support or serve in the Marine Corps Infantry in its effort to win our nation's battles.

Infantry units train to accomplish tasks across the spectrum of modern warfare. From amphibious landings and seizures to humanitarian support, the infantry remains capable of providing the manpower to carry out its mission. Because fighting in combat presents the highest risk to personnel and national security, the infantry maintains its proficiency and focuses its training on combat operations. This bias is apparent in its mission statement: "The primary mission of the infantry is to locate, close with, and destroy the enemy by fire and maneuver or to repel his assault by fire and close combat" (Department of Defense [DoD], 1998).

Because of its focus on the demands associated with combat, infantry Marines experience higher physical demands than Marines in other MOSs. As stated in *Warfighting* (USMC, 1997), "Basic individual skills are an essential foundation for combat effectiveness and must receive heavy emphasis." Physical fitness remains a paramount basic skill of a Marine infantryman and grows in importance as individual gear increases in quantity. Today, combat gear loads span from a "fighting load" at 50.35 pounds to a "sustainment load" at 152.87 pounds (USMC, 2016). Current infantry training standards include conducting a "forced march" every 18 months at minimum; this entails carrying a load of 90 pounds (+/- 10%) in equipment for a distance of 20 kilometers in less than 5 hours (United States Marine Corps, 2016). Required capabilities such as these arrived from lessons learned and historic studies; they are not arbitrarily established. For example, in the Korean War, American forces advanced close to 55 miles to Chosin Reservoir. Because the route selected consisted of a single unpaved road, a lot of the movement required walking (Rasula, 2006). Though technology has advanced since the Korean War, the military cannot rely solely on air or vehicle transportation. Long ground marches with the supplies to self-sustain remains a key strength of the infantry.

B. POLICY CHANGES TO GENDER LIMITATIONS IN COMBAT

Through most of the Marine Corps' history, some occupational fields remained "closed" to women. Any MOS falling within the combat arms spectrum restricted its personnel to males; this includes the infantry. In 1993, the branches of the military acted in accordance with Secretary of Defense Leslie Aspin's task to analyze and recommend which closed occupational fields could be opened to women, and the cost of doing so. In 1994, the Secretary of Defense published the Direct Ground Combat Definition and Assignment Rule (DGCDAR). The document intended to expand opportunities in the military for women who serve. It ruled that women could serve in units that may deploy to direct combat, but could not serve these units at a level lower than the Brigade (Gebicke, 1998). This meant that Combat Arms MOSs, to include all infantry occupations, remained closed to women, and could only serve in support or staff positions.

In 2013, Secretary of Defense Leon Panetta tasked each branch of service to provide detailed implementation strategies of which additional MOSs could be opened women and how each branch would implement their new policies or which MOSs each branch requested exemption from opening (Vergun, 2013). The Marine Corps thoroughly researched similar jobs such as firefighters, smoke jumpers, and police special weapons and tactics (SWAT) team members on female integration (Amos, 2013). It also conducted an experiment; Former Commandant of the Marine Corps, General Amos, described the experiment in a *Marine Gazette* article:

> We are establishing a GCE Integrated Task Force. This unit of approximately 500 Marines includes about 120 female Marine volunteers from across the Corps. The reason for the relatively high number is to ensure that every task that this unit undertakes includes female Marines. The female Marine volunteers are going through the ELT training for a designated ground combat arms MOSs (e.g., 0311 (rifleman), 0331 (machinegunner), 0341 (mortarman), 0811 (field artillery cannoneer), 1812 (tanker), etc.). We solicited MOS-qualified male Marines to volunteer for the GCE Integrated Task Force from our Active and Reserve Component forces.
>
> The Integrated Task Force will conduct training in company- and battery-level collective tasks at its home station. When that training is complete, this unit will conduct offsite training, like many of our Operating Forces units, in locations such as the Marine Corps Air-Ground Combat Center Twentynine Palms, Camp Pendleton, and the Marine Corps Mountain Warfare Training Center. The GCE Integrated Task Force will use deployments to these training centers to conduct collective training and evaluation up to the company and battery levels. By assessing individual Marines in an integrated unit in their performance of our individual and collective tasks under demanding and realistic conditions, we will be able to answer the following question: What are the physical, physiological, and performance characteristics that predict success in each combat arms MOSs? (Amos, 2013)

Following results of the experiment, the Marine Corps published and began implementing Fragmentary Order 4 Marine Corps Female Integration Plan (MCFIP), its plan to integrate women into all occupations by January 1, 2016 (DoD, 2015). Since implementation of MCFIP, one female has passed the Infantry Officers Course (IOC) and multiple Infantry Training Battalion (ITB) classes included females graduating with infantry occupations.

Before and throughout this policy change, women have been attending integrated Marine Combat Training (MCT) courses since 1997 (Ogden, 2018). With the Marine Corps' desire to achieve 10% of the Marine Corps composed of females, anticipating secondary effects grows in importance (Bennet, 2016). Because the Corps is prioritizing an increase in female personnel across all MOSs, attrition of females should warrant investigation. My study analyzes if there are differences in injury rates leading to attrition between genders at both MCT and ITB that may be affected by gender integration goals.

C. ORGANIZATION OF THE SCHOOL OF INFANTRY

1. The School of Infantry (SOI)

The Marine Corps established the School of Infantry in World War II. Growing and shrinking the force with wartime demands led to the establishment of an East and West Coast school locations. Dove and Richmond detail the history of SOI in their research (2017). The SOI-East schoolhouse is located at Camp Geiger, North Carolina. The SOI-West schoolhouse is located at Camp Pendleton, California. Each SOI schoolhouse retains command of subordinate schools. Both schoolhouses contain their own Infantry Training Battalions (ITB), Marine Combat Training (MCT), and Combat Instructor School units; however, SOI-West contains more subordinate units than SOI-East. Figures 1 and 2 illustrate the schoolhouse hierarchy at SOI-West and SOI-East respectively. My research focuses on MCT and ITB because they capture the infantry training following a Marine's graduation from recruit training. At this point in Marines' careers, the Marine Corps has invested a lot of money into the human capital of its recruits; attrition due to injury represents a misallocation of resources.

Figure 1. Command Diagram of SOI-West.
Source: Dove and Richmond (2017).

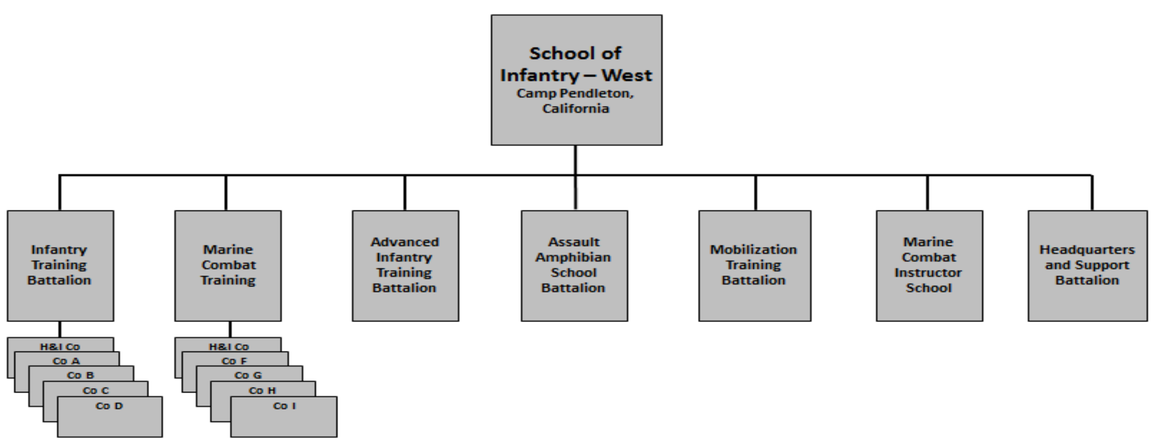
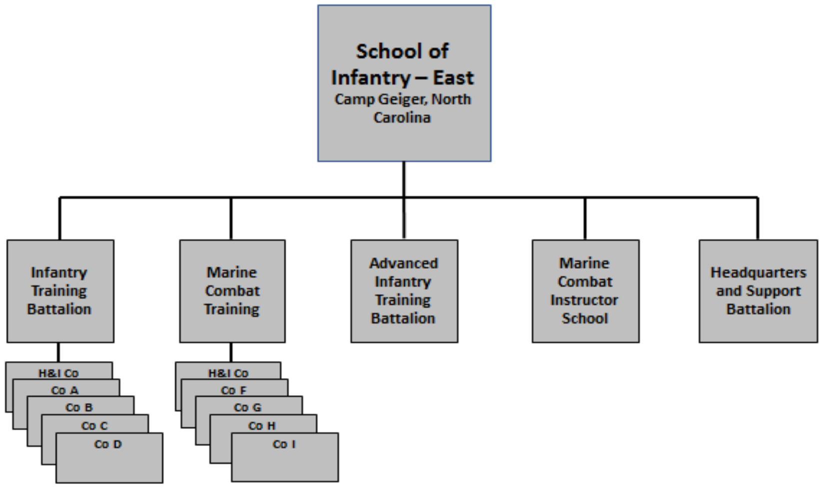


Figure 2. Command Diagram of SOI-East.
Source: Dove, Richmond (2017).



Many factors indicate that additional differences between schoolhouses exist regarding environmental and cultural factors. Climate and terrain differ posing different risk of injury between schoolhouses. Demands of each SOI schoolhouse differ presenting possible differences in priorities of resource allocation. Lastly, the combat instructors' experiences may differ affecting cultural differences in instructor techniques. All of these considerations likely create differences in the educational and training environments that may affect injury rates.

1. Infantry Training Battalion (ITB)

ITB holds the responsibility to train all entry-level infantry MOSs: 0311 Rifleman, 0331 Machine Gunner, 0341 Mortarman, 0351 Assaultman, and 0352 Anti-Tank Missileman. ITB trains these Marines for 52 days resulting in Marines trained and capable of executing the same basic infantry tasks as students of MCT; once completed each respective infantry MOS divides for additional training for their specific MOSs (Infantry Training Battalion, n.d.). At the conclusion of training at ITB, operational units absorb the ITB graduates to begin training for operational deployments. The new graduates must arrive with proficiency in all skills trained at ITB in order to enhance and not hinder their new units' capabilities. Subsections B-F in the appendix illustrate the instruction schedule at ITB based on MOS.

2. Marine Combat Training (MCT)

MCT trains non-infantry Marines who graduate from recruit training. MCT lasts 29 days and serves to train Marines on basic infantry skills prior to their transfer to their assigned MOS school. The school demands physical exertion and trains Marines in individual infantry skills outlined in the Infantry Training and Readiness Manual as 1000-level tasks (USMC, 2016). These skills are known as basic infantryman skills, more commonly referred to as basic skills or 0300 skills. Figure 3 illustrates the prescribed 1000-level tasks of an infantry rifleman. All Marines receive 0300 skills from their SOI schoolhouse regardless of MOS; however, if not designated with an infantry MOS, Marines' infantry training at SOI only includes the 0300 training shown in the appendix, Section A. Between both training locations, ITB and MCT strive to standardize training between the two sites.

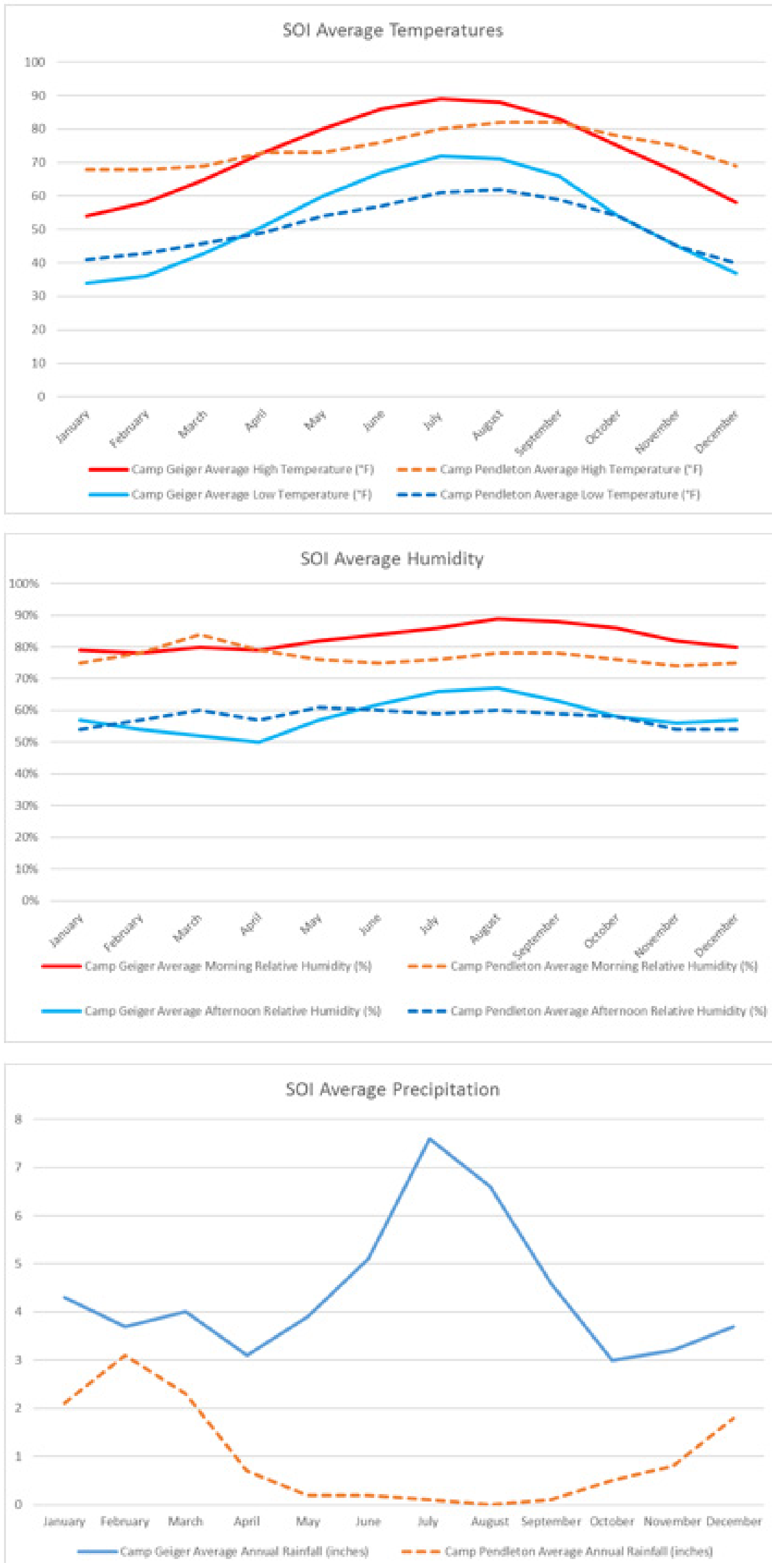
Figure 3. Index of 1000-Level Individual Events for Infantry Riflemen. Source: USMC (2016).

Event Code	Event
1000 Level Events	
0300-CMBH-1001	Conduct observation
0300-CMBH-1002	Identify anomalies
0300-CMBH-1003	Identify spoor
0300-CMBH-1004	Apply the components of the decision cycle (OODA) process
0300-COMM-1001	Communicate using hand and arm signals
0300-COMM-1002	Communicate using limited visibility signals
0300-COMM-1003	Communicate using wired communications
0300-COMM-1005	Operate a VHF field radio
0300-COMM-1006	Submit a message
0300-COND-1001	Conduct a forced march
0300-DEF-1001	Construct a two-man fighting hole
0300-DEF-1002	Construct a hasty fighting position
0300-DEF-1003	Defend a position
0300-DEMO-1001	Emplace an M18A1 Claymore mine
0300-DEMO-1002	Engage a target with an M67 fragmentation grenade
0300-M203-1001	Maintain an M203 grenade launcher
0300-M203-1002	Perform weapons handling procedures for the M203 grenade launcher
0300-M203-1003	Perform misfire procedures for an M203 grenade launcher
0300-M203-1004	Zero a M203 grenade launcher
0300-M203-1005	Engage targets with a grenade launcher
0300-MED-1001	Perform tactical field care on a casualty
0300-MOUT-1001	Perform individual movement in an urban environment
0300-MOUT-1002	Perform individual actions while clearing a room
0300-OFF-1001	Perform actions in a hasty firing position
0300-OPS-1001	Conduct a Pre-Combat Check
0300-OPTS-1001	Utilize limited visibility devices
0300-PAT-1001	Determine the error in a lensatic compass
0300-PAT-1003	Navigate with a map and compass
0300-PAT-1004	Prepare for combat
0300-PAT-1005	Perform individual movement techniques
0300-PAT-1006	Handle detainees
0300-PAT-1007	Perform individual actions in passage of lines
0300-PAT-1008	Perform individual actions in a patrol
0300-PAT-1009	Perform immediate actions
0300-PAT-1010	Perform individual actions from a vehicle
0300-PAT-1011	Visually identify Improvised Explosive Device (IED)
0300-PAT-1012	React to an Improvised Explosive Device (IED)
0300-RFL-1001	Perform weapons handling procedures
0300-RFL-1002	Perform weapon maintenance
0300-RFL-1003	Zero the weapon
0300-RFL-1004	Demonstrate Basic Rifle Marksmanship Skills
0300-RFL-1005	Demonstrate Basic Combat Rifle Marksmanship
0300-RFL-1006	Engage mid to long range threats (day)
0300-RFL-1007	Zero the night aiming device
0300-RFL-1008	Engage mid-range threats (night)
0300-RFL-1009	Engage Short Range Threats (Day)
0300-RFL-1010	Engage Short Range Threats (Night)
0300-RFL-1011	Engage Moving Threats
0300-TVEH-1001	Assist in loading and unloading a tactical vehicle
0300-WPNS-1001	Inspect the AT-4 light anti-armor weapon
0300-WPNS-1002	Engage target with an AT-4 light anti-armor weapon
0300-WPNS-1003	Perform misfire procedures for an AT-4 light anti-armor weapon
0300-WPNS-1004	Engage targets with an M72 series weapon
0300-WPNS-1005	Perform misfire procedures for a M72 series weapon
0300-WPNS-1007	Inspect the M72 series weapon

3. Geographic and Weather Information

SOI-East resides at Camp Geiger in North Carolina near sea level with mostly flat or gently sloping terrain. Its climate includes hot humid summers. SOI-West, located at Camp Pendleton, California, is also a coastal location. Steep and rocky hills with dry and compact dirt comprise its terrain. It is common knowledge among Marines that Camp Pendleton experiences much more consistent weather than Camp Geiger, but Camp Pendleton contains much steeper terrain with rocky undulations to traverse. Figure 4 illustrates the different climate experienced at each location as well as comparisons in rainfall.

Figure 4. Weather Information Camp Geiger and Camp Pendleton. Adapted from MyForecast (n.d.a) and (n.d.b).



4. Combat Instructors

The cadre of instructors for SOI must attend Combat Instructor School and certify as combat instructors. Each schoolhouse manages its own combat instructor certification. The learning objectives and certification for Combat Instructors are standardized; however, the location where each instructor is certified depends on geographical assignment. Camp Pendleton Combat Instructors attend Camp Pendleton's Combat Instructor School and likewise for Camp Geiger Combat Instructors. If a Combat Instructor serves at a deployable unit, then returns to SOI as a Combat Instructor, they are not required to repeat the entire Combat Instructor School; however, they must re-certify through a "challenge" course regardless of location (USMC, 2017). This means that initially, a Marine may receive Combat Instructor training at one location, then later re-certify through a school at the other location. This indicates that instructor culture may differ between training locations but unlikely to affect injury significantly. This speculated lack of difference stems from instructors' attendance at either Combat Instructor School or the challenge course at the same location that they instruct.

5. Location Differences in Injury Rates

Camp Pendleton and Camp Geiger possess differences affecting injury rates of students at MCT or ITB. Considering these speculated differences in environment and culture, this study analyzes the extent injury rates differ based on these differing factors between schoolhouse locations: Camp Geiger and Camp Pendleton.

D. SUMMARY

The Marine Corps' combat abilities in austere environments remains its central purpose. Because of this, training must remain challenging to meet the demands of combat in "every clime and place" (USMC, n.d.c). Finding differences in gender or location that influence the likelihood of injury directly affects the Marine Corps' combat readiness. Differences exist between genders abilities and training experience base on location, I show in the following chapters these differences.

III. LITERATURE REVIEW

A. GENDER DIFFERENCES

1. Anatomical Differences in Gender

a. Army Medical Findings

Men and women are born with genetic differences that manifest into physical abilities and limitations. Because the Marine Corps staffed its infantry entirely with men until recent policy changes, its policies, physical standards, and methods target the average male recruit. As shown in the *Infantry Training and Readiness* manual, infantry Marines require the capability to conduct foot movements carrying heavy loads. Prescribed gear loads range from 50 to 152 pounds depending on the prescribed mission or task. Distances to carry these various loads include up to a 20-kilometer movement at one time (USMC, 2016). Because the average female recruit weighs less than the average male recruit, the prescribed hiking loads are, on average, proportionally heavier for female Marines compared to males.

Military medical teams conducted an analytical review of historical, physiological, biomechanical, and medical aspects of load carriage in military operations. Their focus remained on the effects of load carriage on the average soldier and ways to improve capabilities from a physiological perspective. When analyzing differences in load carriage between genders, the authors find that women use a shorter stride and more steps compared to men carrying the same weight (Friedl & Santee, 2012). Women's stride length shortens as hike load increases. The authors observe that women also lean farther forward, hyperextending their necks as hike load increases compared to men (Friedl & Santee, 2012). When controlling for body composition and size, the authors observe the same differences between men and women. When comparing men and women hiking 10 kilometers carrying loads of 18, 27, and 36 kilograms, the authors find men completed the movements on average 21% faster than women completed the same movements (Friedl & Santee, 2012).

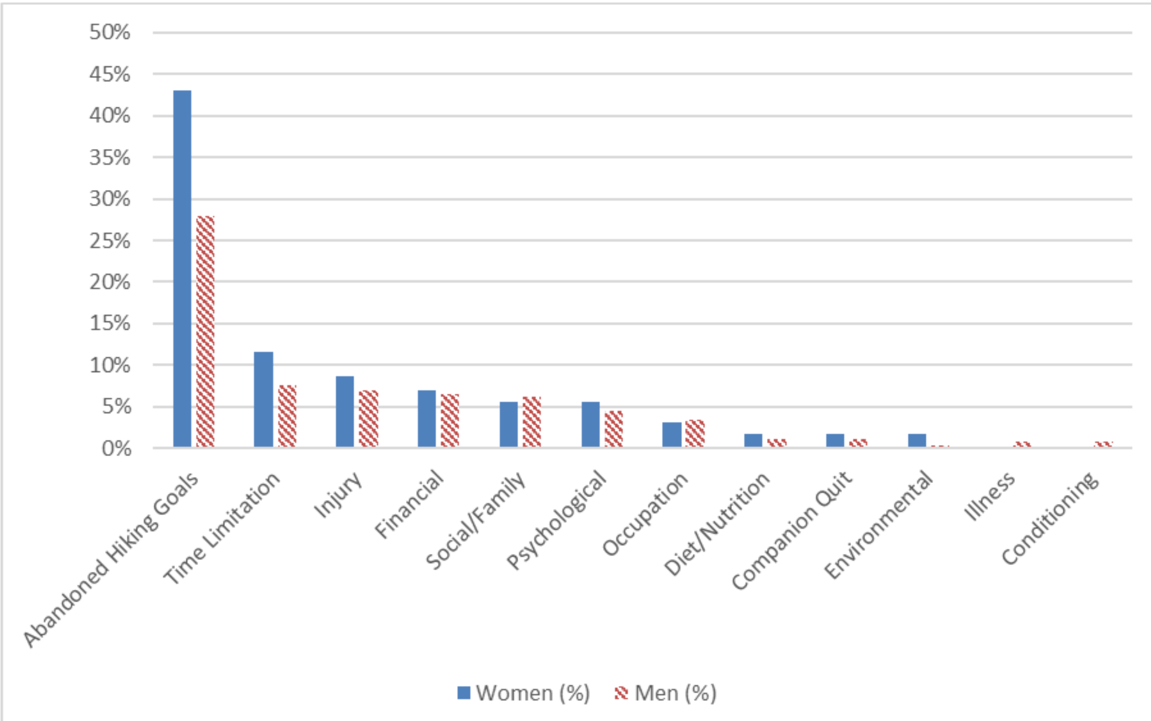
Friedl and Santee expand on injuries from carrying heavy loads during foot movements and conclude this directly contributes to injury. They analyze a data set of 355 infantry soldiers during a 20-kilometer maximal effort road march and a second data set of 218 infantry soldiers during a 5-day, 161-kilometer road march. The 20-kilometer road march yielded 91 reported injuries; the 5-day road march yielded 102 reported injuries (Friedl & Santee, 2012). Because men and women use different techniques when marching with heavy loads, injury differences may exist between genders within the infantry.

b. Long-Distance Backpacking

Few occupations outside of the military require individuals to carry heavy loads for long distances, especially within the average ages of a Marine Recruit, 18–21. Among the few activities that exist similar to infantry road marches, long-distance backpacking presents similar physical demands. A 2004 study surveys 334 backpacking volunteers as they backpacked the Appalachian Trail. Of the 334, 280 returned the survey. Of the 280, 72 were women with an average age of 33 and 208 were men of average age 35. The study intended to differentiate gender experiences with injury, illness, and other factors causing the backpackers to abandon earlier than intended. The study reveals little difference in injury or illness between genders. Differences exist in hypothermia as 10% of the surveyed women reported it, and 3% of the surveyed men report it (Boulware, 2004).

Of the respondents, 191 attain their completion goal; however, large differences exist between the genders. Of the 208 men, 72% reached their goal; of the 72 women, 57% reached their goal. The responses containing reasons for abandoning hiking goals are outlined in Figure 5; the respondents were afforded the opportunity to mark more than one reason for abandonment. As shown, women listed injury as a reason for abandonment at higher rates than men. Additionally, men's backpacks weighed, on average 3.3 kilograms (7.27 pounds) more than female respondents, and men lost more body weight while hiking than women did (Boulware, 2004). This indicates that metabolism differences or nutrition habit differences may exist between the genders within the sample, and that within those who select to backpack the Appalachian Trail, men experience different effects from additional backpacking weight. Backpacking and hiking resemble many of the physical demands of Marine training. Because of the similarities, injury rates of backpackers may plausibly resemble those of Marine infantry training.

Figure 5. Reasons for Abandoning Appalachian Trail by Gender. Adapted from Boulware (2004).



2. Gender Differences in Injury Rates

a. Anterior Cruciate Ligament (ACL) Injury Rate Studies

(1) Naval Academy

A study published in 2000 gathers medical data on midshipmen at the Naval Academy with the purpose of analyzing ACL injury rates between genders, experienced athletes, and inexperienced athletes under the physical requirements at the institution which differ from a typical public or private college because all midshipmen must participate in sports as well as military training. To define and standardize their sample, they define an athlete-exposure as the National Collegiate Athletic Association (NCAA) Sports Medicine does, "any practice or game in which an athlete is exposed to the possibility of an athletic injury" (NCAA, 1998). Data collected includes all midshipmen from June 1991–1997; students who underwent ACL reconstructive surgery prior to attendance at the Naval Academy were excluded from their sample. The research team compiles statistics on the total number of athlete-exposures based on type of sport and competition level (intramural or the intercollegiate level) through questionnaires solicited through team coaches and the Naval Academy Registrar's office (Gwinn, Wilckens, Mcdevitt, Ross, & Kao, 2000).

Analysis of aggregate data reveals that women at the Naval Academy held a relative risk of ACL injury of 2.44 compared to their male counterparts. When comparing males and females competing in intercollegiate sports, female relative risk increased to 3.96 when averaged across all intercollegiate sports. When comparing intramural sports the female relative risk drops to 1.40, and falls short of statistical significance, when averaged across all intramurals. When comparing men and women in ACL injuries sustained during military training, female relative risk rises drastically to 9.74 and regains statistical significance when averaging the two military activities required at the time, instructional wrestling and the obstacle course (Gwinn, Wilckens, Mcdevitt, Ross, & Kao, 2000). This indicates that women who self-select into military training are at much higher risk than men for sustaining an ACL injury. I speculate that this relative risk dropped since this study's publication because training policies and standards have since changed to better integrate both genders into all aspects of the U.S. military. Though better policies exist, female service-members likely remain at higher risk of ACL injuries when compared to their male counterparts.

The authors' study of ACL injuries observe a sample of military members. The midshipmen of the U.S. Naval Academy endure many Navy and Marine training events throughout their four-year studies. This study captures a similar demographic to my research and thus may yield similar results because of the similar conditions of the sample.

(2) West Point

Similar to the Naval Academy study, a team of researchers examines ACL injury rates at the U.S. Military Academy, West Point. Using data from 1994–2003 including students from West Point; a team of researchers analyze the incidence rate students experienced ACL injuries. The study focuses on the incidence rates based on gender and sport; because West Point serves as a military academy, it requires cadets to participate in sports and military training just as the Naval Academy does. For this reason, the researchers included military training, close quarters combat, and the indoor obstacle course included as sports variables for analysis. They analyzed 10,419 students, 86.6% male and 13.4% female, using a Poisson regression model to find the rate of ACL injury per 1000 students. ACL injuries totaled 353 incidents with females comprising 13.9% of the incidents (Mountcastle, Posner, Kragh, & Taylor, 2007).

When comparing aggregate data, the researchers note that certain sports remain gender specific throughout most of the period of observations, such as football, wrestling, and rugby. When analyzing the aggregate data, they find no significant difference in incidence rate between males and females. However, in further analysis they drop the three male-only sports and find statistically significant differences between genders. When aggregating the remaining sports, they find that the female ACL injury rate was 1.51 times greater than males. For military specific activities, women suffer ACL injuries at a higher rate than men did. Table 1 shows the number of occurrences of ACL injuries within the military activities covered in the study with the associated percentage of the total ACL injuries within each respective gender (Mountcastle, Posner, Kragh, & Taylor, 2007).

Table 1. Total Number (%) of ACL Injuries by Sport and Gender. Adapted from Mountcastle, Posner, Kragh, and Taylor (2007).

	Total ACL Injuries (%)	
Sport/Activity	Women, n (%)	Men, n (%)
Close Quarters Combat	0 (0)	2 (0.7)
Indoor Obstacle Course Test	5 (9.8)	9 (3.0)
All Military Training	4 (7.8)	8 (2.7)
Total Injuries Excluding Male-Only Sports	51 (100)	302 (100)

The researchers find that close to 18% of the total ACL injuries sustained by women occurred in the military activities, compared to men's approximate 7%. This research shows that when comparing men in women in similar physically demanding activities, women tend to suffer ACL injuries at higher rates. This research resembles my research demographics and scope. By controlling for additional activities as the Naval Academy study, the researchers yield similar results but with less magnitude, (Gwinn, Wilckens, Mcdevitt, Ross, & Kao, 2000). By following techniques of both research teams, I can produce more accurate results.

b. Military Training Studies

(1) Ground Combat Element – Integrated Task Force (GCEITF)

In 2014, the Marine Corps formed the GCEITF to experiment and analyze the effects of integrating women into all MOSs as directed by the Secretary of Defense. It constructed control and treatment groups that resembled an infantry battalion with supporting combat arms units attached (tanks, light-armored reconnaissance, combat engineers, artillery, etc.). The study constructed the battalion from randomly selected male and female Marines of desired ranks to fill a military hierarchy. These individuals created units comprised of non-infantry males and females, infantry males and non-infantry females, and infantry males with non-infantry males. In total, 300 male and 100 female Marines participated in the experiment that ended in 2015 (MCOTEA, 2015).

The units performed most of the tasks required of an infantry battalion training prior to operational deployments. All non-infantry Marines participating in the experiment attended ITB receiving the same entry-level infantry training as designated infantry Marines. The study used various regression techniques to analyze different aspects of the study. When analyzing injury, the research team considered the training days lost due to injury. They utilized a zero-inflated negative binomial regression to analyze the results between the genders. The researchers found that the female participants were 19 percentage points more likely to lose training days because of injury compared to their male non-infantry counterparts (MCOTEA, 2015). Given that all non-infantry volunteers received the same instruction prior to experimentation (ITB), the study indicates that given the same circumstances, female Marines would likely sustain injuries that correlate to missed training days if no differences existed between female recruits at the time of the experiment and today. Since the experiment, the Marine Corps requires all infantry recruits to perform the GCA-IST for screening purposes prior to recruit training. This additional screening likely decreases the likelihood of missed days due to training upon entering ITB.

(2) Army Recruit Training

In 2000, a team of researchers examined data on 861 Army trainees through their 8-week basic combat training (Bell, Mangione, Hemenway, Amoroso, & Jones, 2000). The sample included 509 men and 352 women. The study controlled for physical ability upon entering the training. The results indicate that on average men entered training with better physical scores than women, but that women experienced higher improvements in physical test scores by the end of training (push-ups, sit-ups, running). The researchers consider the cost of injury as a result of these improvements; they find that women in this sample had a relative risk of one or more injuries of 2.1 when compared to the men. More concerning, women had a relative risk of sustaining a time-loss injury (an injury that causes lost training time) of 2.4 compared to the men. In an attempt to identify predictors of injuries, the researchers grouped the candidates into running ability groups: very fast, fast, average, slow, and very slow. Using logistic regression, they found that trainees in the slow and very slow running groups possessed a higher relative risk of injury than the relative risk of being female (Bell, Mangione, Hemenway, Amoroso, & Jones, 2000).

This research shows that though women sustain a higher injury rate than men, the best predictor of injury remains physical ability and performance. I suspect that the running ability predictor used in this study serves partly as a proxy variable for motivation. Because this study analyzed Army trainees from 1988, I speculate that these women were recruited from a limited population because of the different social acceptance of women in the military at the time. Since this time, recruiting policy and social changes likely contribute to a larger population of physically fit women from which the services recruit with lower risk of injury. I anticipate that female recruits of the present day possess characteristics better suited for today's military.

3. Gender Differences in Long-Term Effects of Injury

As stated, ample studies show that women sustain injuries at equal or higher rates than men placed under similar military conditions. This affects readiness and recruiting, but mostly in the short-run. From the Marine Corps' perspective, long-term effects of injury need to be considered in initial training when calculating the cost of medical benefits after discharge from service. Though little research supports differences in long-term effects of injury based on gender, some find that women suffer worse long-term effects of traumatic brain injury (TBI) when compared to men. In a 1987 study, Edna and Cappelen analyze TBI effects on gender 3–5 years after injury occurrence; they used a treatment group who suffered TBI and a control group of individuals without suffering TBI. They find that women who sustained a TBI displayed worse symptoms than men 3–5 years after the incident. The researchers find the following self-reported symptoms to differ with statistical significance between women and men: headache, dizziness, irritability, insomnia, depression, and double vision (Edna & Cappelen, 1987).

No research on SOI reveals trends in specific types of injuries, but capturing details of injuries might reveal trends similar to Edna and Cappelen. If trends in injuries reveal TBI or concussion to exist at MCT and ITB, the long-term effects need to be considered not only for future medical costs, but for the secondary effects of these injuries and the different negative effects they have on women compared to men. Investigating the differences in the long-term effects of musculoskeletal injuries would also aid in policy developments of this type.

B. GEOGRAPHICAL EFFECTS ON INJURY

Limited research exists on how geographic location affects injury rates or risk of injury. Countless differences exist between two separate training locations, especially when located on opposite coasts of the continental United States like Camps Geiger and Pendleton. However, climate differences are clear and illustrated in Figure 4. Camp Pendleton experiences consistent weather throughout the year; on the other hand, Camp Geiger receives sweeping weather changes depending on the season. Compared to Camp Pendleton, Camp Geiger's winters sink to much colder temperatures, its summers rise to higher temperatures, its humidity remains consistently higher, and it receives much more annual rainfall. I speculate weather conditions affect injury rates.

An observational study conducted in Quantico, Virginia at the Marine Corps' Infantry Officers Course (IOC), observed a small sample (14) of Marine Infantry Officer Students (Hoyt et al., 2001). The students wore physiological status monitors through their final 10-day field exercise. The research intended to analyze the effect that intense activity, limited sleep, and restricted food supply under cold and damp conditions had on the individual Marine. Along with results regarding insufficient calorie intake, the researchers found that cold weather directly affected core body temperature, further affecting sleep disruption given the gear issued to the students at the time of training (Hoyt et al., 2001). Sleep deprivation negatively affects health. An article in "The Medical Clinics of North America" journal describes the links between sleep deprivation and negative effects on the immune system (Carskadon, 2004). Another source describes the extent to which sleep deprivation negatively affects cognitive abilities (Dorrian & Dinges, 2005). Knowing that sleep deprivation has negative effects on health, I speculate that cold conditions could lead to sleep deprivation and thus increase the risk of injury and the cognitive abilities normally present to actively avoid injury. In an infantry training environment where risk of injury increases compared to the average American's environment, cold weather that causes sleep deprivation may compound the problem.

C. RESEARCH PREDICTING SUCCESS IN MILITARY SCHOOLS

1. Marine Corps Basic Reconnaissance Course Research

Until recently, graduation from Marine infantry training courses was limited to male Marines. This creates challenges in predicting what characteristics of female Marines lead to graduation, or more importantly, injury avoidance. However, trends in two studies find similar predictors for Marines who complete infantry schools. Nowicki (2017) analyze predictors of success at the Marine Corps' Basic Reconnaissance Course (BRC). He analyzes a sample of 1,588 male, self-selected, and pre-screened Marines using survival analysis. He found that over 27.08% of the observations failed to finish the course because they chose to drop on request (DOR), and 17.29% failed to finish because of medical reasons (injury or illness). When constructing predictive models, he found that PFT scores, General Test (GT) scores, and passing the land navigation evaluation positively correlated to graduation (Nowicki, 2017). These results indicate that only analyzing physical attributes does not capture all characteristics needed to graduate because GT score measures intelligence similar to intelligence quotient (IQ) and land navigation requires both physical fitness for the long movements and critical thinking skills.

2. Infantry Training Battalion: A Predictive Model for Success under Female Integration

BRC shares similarities with infantry training and expands upon infantry skills to make Marines capable of specialized missions. It screens Marines who already graduated ITB. For this reason, BRC predictors of success may not perfectly transfer to Marines just graduating recruit training. In an attempt to achieve a 10% female composition of the force, analysis of Marines at ITB may provide predictors of success for females recruited with infantry contracts. Dove and Richmond analyzed 42,153 Marines attending ITB from 2010–2017 and then analyze failure among 1,616 Marines attending ITB at SOI-West from 2016–2017, after all MOSs were made available for women (2017).

Their results from 2010–2017 resemble the results found by Nowicki's analysis of BRC. Armed Forces Qualification Test (AFQT), PFT, CFT, Rifle Qualification Score, Height, and Weight all positively correlated to graduation at ITB. This indicates that both physical characteristics and intelligence contribute to success at ITB, similar to success at BRC. When using a multinomial logit model for ITB students from 2016–2017, they found that 58.33% of the dropped Marines failed due to inadequate scores on MOS specific physical standards, and 20.83% failed due to physical health. Dove and Richmond conclude that physical abilities best predicted failures in this sample and intelligence had little effect on outcome (2017). Because the Marine Corps uses different standards for the PFT and CFT based on gender, predicting female success remains speculative based on Dove and Richmond's results. This also indicates that women do not need to run as fast or perform as many repetitions as men on the PFT and CFT to succeed at ITB.

I speculate the characteristic motivation remains omitted from both studies, and would serve as the strongest predictor of injury for both men and women. Until data with a high number of observations on female graduates of ITB exists, research of ITB remains unable to transfer the male predictors of success to female infantrymen. This remains the case because men and women have different physical standards until attending ITB. The weights of individual events in the PFT and CFT (run time, crunches, ammo can lifts, etc.) differ based on gender. Until a universal physical standard exists, projecting male physical test predictors onto female candidates will likely suffer from biases in the model.

D. CHAPTER SUMMARY

Based on review of previous research I find that experts agree that men and women differ in their average physical abilities. Though military studies indicate women sustain injuries at a higher rate than men, a civilian study of backpackers, an activity with similar demands to some military training, indicates that women did not sustain injuries at a different rate than men. Research following women after sustaining head injuries indicates that women and men experience different long-term effects from brain injuries and needs considered in military medical policy. Aside from gender differences, training location may cause differences in injury loosely based on injury as related to weather conditions. Previous related research indicates that only controlling for demographics and physical capabilities fails to capture a proper predicative model of success in the military. Controlling for intelligence yields correlations to success in military training courses.

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IV. DATA AND METHODOLOGY

A. INTRODUCTION

This chapter details the data received for analysis, the samples used from each data source, and the final samples used for analysis. Data sources include the Marine Corps' TFDW, SOI-East, and the Navy EpiData Center. Details of each model's variables analyzed are included.

B. DATA SOURCES

1. Total Force Data Warehouse (TFDW)

Data received from TFDW forms the basis of my analysis. TFDW houses all personnel data from the Marine Corps Total Force System (MCTFS). The data received includes all Marines assigned to SOI-East or SOI-West as students from fiscal year 2012–2018. It contains 406,486 observations. After excluding repeat observations of the same individual, I keep the earliest observation of each individual while assigned to SOI. After these exclusions, 199,154 observations remained.

2. School of Infantry East - Sports Trainer Office

From SOI-East, the sports trainer's office provided detailed information on Marines seen for injury. It included more detailed injuries and more detailed statuses of Marines than TFDW. The office at TFDW merged this data with the previously described data from TFDW to maintain subject anonymity.

3. EpiData Center Department

The Navy and Marine Corps Public Health Center houses the medical data for both the Navy and Marine Corps. Within their chain of command, the EpiData Center Department compiled aggregate data on reported injuries of Marines at ITB and MCT from 2016–2018. The product provided is attached in appendix, Section I. It provides aggregate statistics comparisons between reported injuries between SOI-East and SOI-West categorized by body location, type of injury, and total number of reported injuries. The data is aggregate data and not merged with TFDW or SOI East Sports trainer data for analysis. This data does not contribute to the analysis of injury drops because it cannot be determined which reported injuries led to injury drops.

C. TARGETING THE SAMPLE

TFDW cannot provide a means to separate specific schools within each SOI command. To limit the sample to Marines attending MCT and ITB, I include Marines of ranks E1-E3 and exclude the rest. Because of this, I accept bias that some of the Marines of rank E3 likely attend a school outside of MCT and ITB. However, E3 Marines need to be included because if a Marine sustains serious injury and extends their time at MCT or ITB, they can promote to E3 before completion at either course. After excluding ranks senior to E3 and dropping any duplicate observations, my remaining sample includes 198,992 observations.

Table 2. Injury Drops by Rank

INJURY_DROP			
Grade	Not Injured	Injured	Total
E1	112,810	674	113,484
E2	83,876	740	84,616
E3	825	65	890
Total	197,511	1,479	**198,990**

My remaining sample suffers from significant missing data values under the variable SOI_STATUS, the variable that explains the status at their respective SOI course. Available options under SOI_STATUS are illustrated in Table 3. From the 198,990 observations, 59,333 lack any type of SOI_STATUS or injury data from the SOI-East sports trainer. Because no cause exists for these missing statuses, I exclude them from the analysis to avoid unexplainable bias in the analysis, but subject my results to bias if a common reason exists for these observations to lack an entry in SOI_STATUS. Table 4 shows the summary statistics of my data set with the missing data excluded.

To identify which observations are injury drops, I create the variable INJURY_DROP as an identifier using SOI_STATUS and the SOI-East sports trainer data. Those individuals who recorded an SOI Status of "Medical Drop, Will Be Recycled," those who received a status of "Medical Drop, Will Not Be Recycled," or a recorded injury drop from the SOI-East Sports Trainer data received an INJURY_DROP value of 1.

Table 3. SOI-East and SOI-West SOI_STATUS and SOI-East Sports Trainer Summary.

	SOI-East Sports Trainer Injury Drop		
SOI_STATUS for SOI-East anf SOI-West	**NO**	**YES**	**TOTAL**
MISSING DATA	59,333	387	59,720
ACADEMIC DROP, WILL NOT BE RECYCLED	6	0	6
ACADEMIC DROP, WILL BE RECYCLED	3	0	3
ADMINISTRATIVE DROP WILL NOT BE RECYCLED.	21	1	22
ADMINISTRATIVE DROP, WILL BE RECYCLED	84	2	86
ALL OTHER DROPS, WILL NOT BE RECYCLED	10	0	10
ATTEND	1,600	137	1,737
DID NOT ATTEND	2	0	2
DISCIPLINE DROP, WILL BE RECYCLED	2	0	2
DISCIPLINE DROP, WILL NOT BE RECYCLED	50	0	50
EMERGENCY LV DROP, WILL BE RECYCLED	6	0	6
GRADUATE	3	0	3
MEDICAL DROP, WILL BE RECYCLED	228	47	275
MEDICAL DROP, WILL NOT BE RECYCLED	145	5	150
OTHER DROP REASON, WILL BE RECYCLED	0	1	1
PASS	136,390	526	136,916
PREREQUISITE DROP, WILL NOT BE RECYCLED	1	0	1
TOTAL	197,884	1,106	**198,990**

Note. Source: TFDW. Variable SOI_STATUS available entries for a Marine assigned to SOI. Sports Trainer Injury Drop indicates whether to SOI-East Sports trainer recorded the observation as an injury drop.

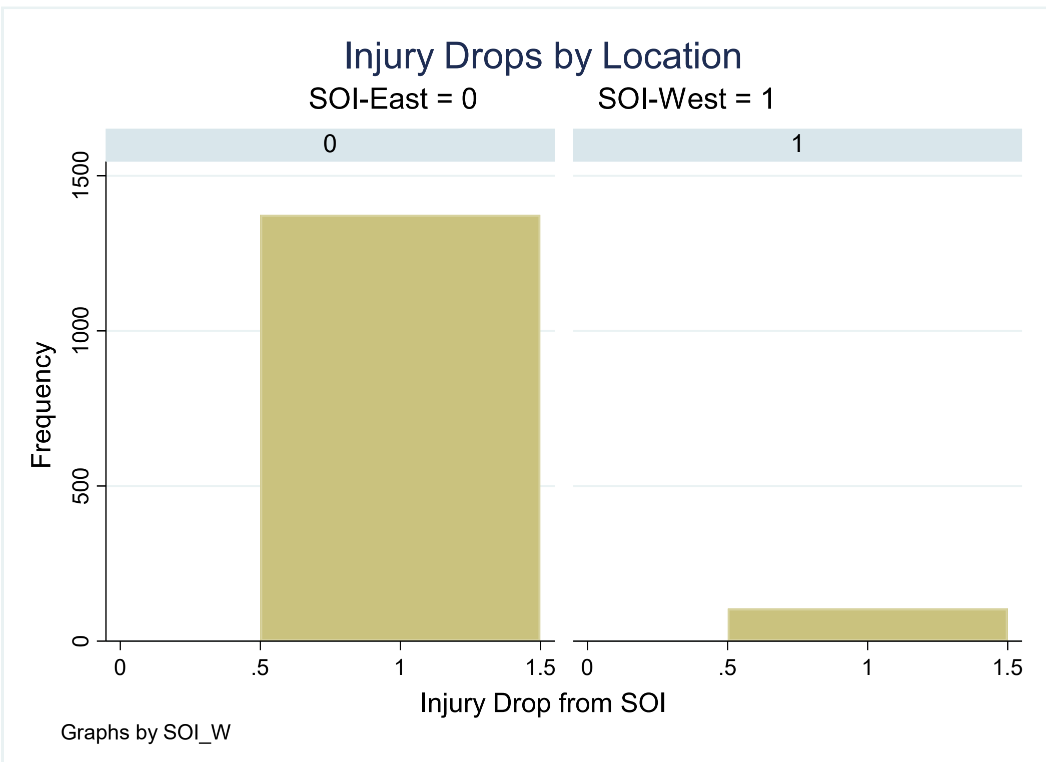
Table 4. Summary Statistics of SOI Data

	Overall	Marines Dropped for Injury	Female Marines
Gender Female=1	0.1106 (0.3136)	0.3834 (0.4864)	1.0000 (0.0000)
Height in Inches	68.4098 (3.2771)	66.9080 (4.4267)	63.7601 (3.2602)
Weight in Pounds	158.2788 (27.1269)	143.5602 (26.9345)	129.5837 (16.6910)
Age in Years	19.4566 (1.8444)	19.5619 (1.9645)	19.4567 (1.9475)
SOI-West = 1	0.4607 (0.4985)	0.0710 (0.2569)	0.0000 (0.0000)
SOI- East = 1	0.5393 (0.4985)	0.9290 (0.2569)	1.0000 (0.0000)
Race African American	0.1183 (0.3230)	0.1075 (0.3099)	0.1520 (0.3590)
Race Asian American	0.0309 (0.1732)	0.0183 (0.1339)	0.0280 (0.1651)
Race White	0.8261 (0.3790)	0.8621 (0.3449)	0.7851 (0.4108)
Races: Pacific Islander, Native American, or Unknown	0.0246 (0.1550)	0.0122 (0.1097)	0.0349 (0.1835)
Married = 1	0.0216 (0.1452)	0.0183 (0.1339)	0.0226 (0.1486)
Number of Children	0.0081 (0.0915)	0.0081 (0.0897)	0.0051 (0.0731)
Physical Fitness Test Score 0-300	253.0378 (29.1123)	246.2669 (36.0741)	255.8259 (30.1156)
Combat Fitness Test Score 0-300	279.3179 (29.0206)	273.1774 (31.1860)	277.6075 (22.2825)
After 2016 Gender Integration Policy = 1	0.3914 (0.4881)	0.3725 (0.4836)	0.4161 (0.4929)
Female = 1 & After 2016 Gender Integration Policy = 1	0.0460 (0.2095)	0.1379 (0.3449)	0.4161 (0.4929)
Average Pro and Con marks for Time in Service	4.2853 (0.1569)	4.1387 (0.4257)	4.3027 (0.1914)
GCA-IST Crunches	81.4267 (20.0678)	79.9425 (20.4526)	76.4279 (20.0893)
GCA-IST Run Time in Minutes	11.4326 (1.8795)	12.0719 (1.4386)	12.8823 (1.1810)
GT Score	107.9509 (11.5309)	105.3283 (11.1946)	102.8584 (10.6876)
Observations	139658	1479	15447

Note: mean coefficients; sd in parentheses. This data set excludes all duplicate observations and observations missing an SOI_STATUS. It includes observations from SOI-East and SOI-West.

Total injuries sustained differed between locations. Based on the data, SOI-East sustained 1374 injury drops and SOI-West sustained 105. The analysis from the EpiData center also found differences in reported injuries found in the appendix, Section I. Figure 6 illustrates the differences in percent of injury drops by SOI location. Until March of 2018, females did not attend MCT or ITB in Camp Pendleton. This leaves the entire data set subject to bias because an insignificant number of women attended MCT or ITB at SOI-West from FY 2012–2018. For this reason, all observations (64,346) from SOI-West are excluded in order to better focus analysis on the effects of integrated training. The final sample analyzed includes 75,312 observations from SOI-East between the ranks of E1-E3.

Figure 6. Injury Drops by SOI Location.

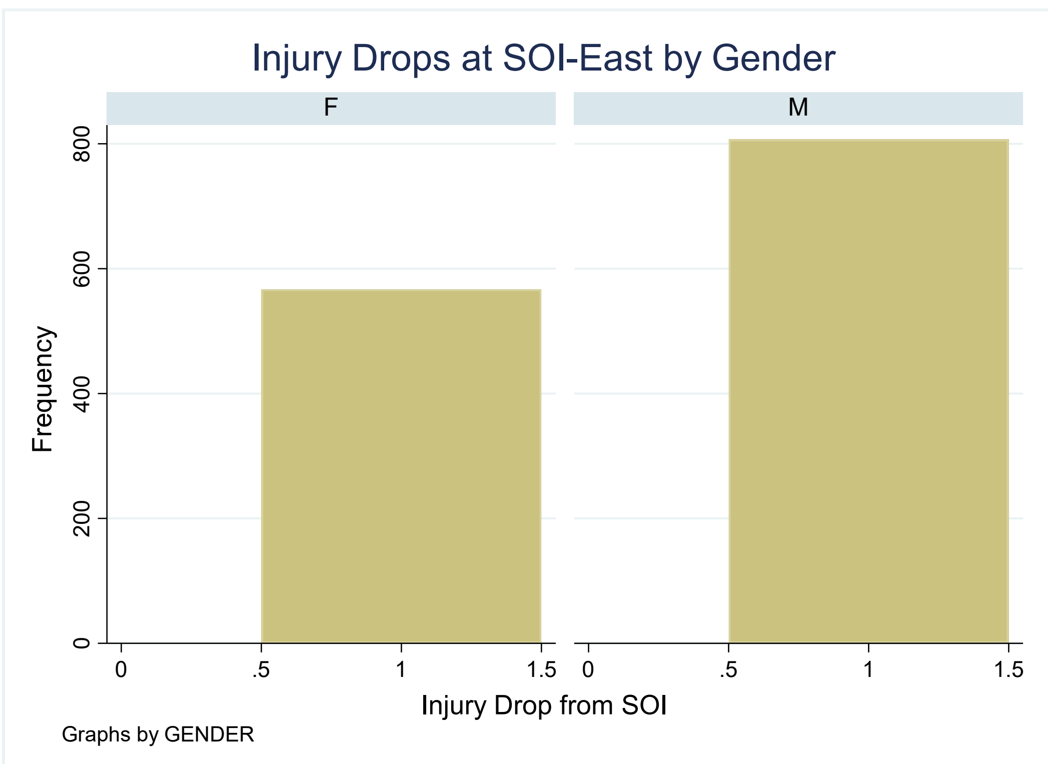


1. Gender Differences

Within the remaining data sample, 59,865 male observations exist and 15,447 female observations exist. Of the 1,374 injury drops, 567 (41.3%) are female and 807

(58.7%) are male. The remaining sample of females at SOI-East sustained a 3.67% drop rate due to injury compared to 1.35% among the males. These totals include those individuals who recorded an SOI Status of "Medical Drop, Will Be Recycled" and those who received a status of "Medical Drop, Will Not Be Recycled, or a recorded injury drop from the SOI-East Sports Trainer data. Figure 7 illustrates the differences in injury drops by gender at SOI-East. Because specific reasons for medical drop are not included in SOI Status, I assume risk of bias because some Marines may medically drop for illness or miscellaneous reasons outside of injury. Regardless, I assume that the sample that medically drops for other reasons remains small and that these other reasons should be included to analyze trends.

Figure 7. Injury Drops by Gender at SOI-East



D. REGRESSION MODELS

1. Logistic Regression

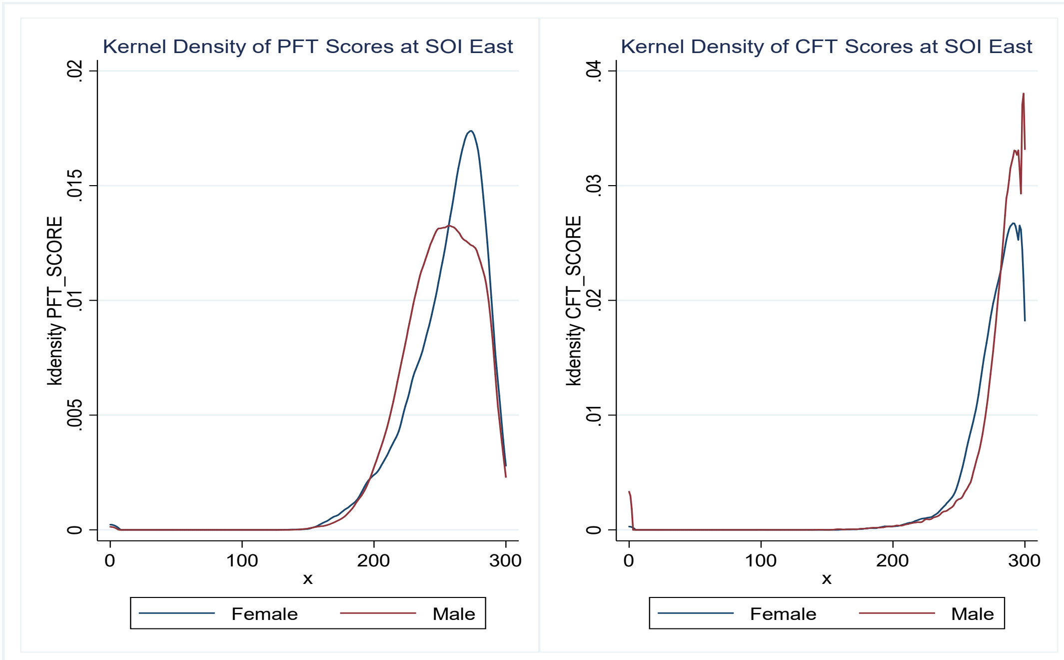
a. Logistic Regression of the Entire Sample

Using a logistic model, I regress probability of injury drop on the variables listed in the equation below. I use the 75,312 observations from SOI-East of which all indicate an SOI Status or injury from the SOI-East sports trainer. INJURY_DROP remains the indication of dropping from SOI due to injury. INJURY_DROP = 1 indicates dropping and INJURY_DROP = 0 indicates not dropping due to injury.

$$\Pr(\text{INJURY\_DROP}) = B_0 + B_1{*}\text{FEMALE} + B_2{*}\text{PFT\_SCORE} + B_3{*}\text{CFT\_SCORE} + B_4{*}\text{GT\_SCORE} + B_5{*}\text{Race} + B_6{*}\text{Family Status} + \varepsilon$$

I chose to use PFT and CFT scores as opposed to the results of individual events (run time, pull-ups, crunches, etc.) because the scores are normalized based on gender. Men require faster run times and more pull-ups to receive an equivalent score to a woman. These normalized scores arrived from the distribution of Marines' abilities throughout the years; I chose to use the scores as to not bias the results because men and women's individual event scores vary, whereas overall score remains close in distribution as shown in Figure 8.

Figure 8. Distribution of PFT and CFT Scores by Gender



GT_SCORE serves as a proxy variable for intelligence. GT_SCORE values come from the results of the military General Technical test, which is similar to the Intelligence Quotient (IQ) test. I control for intelligence to capture the possible effects of more intelligent Marines understanding ways to avoid injury.

I control for all standard demographics to capture any further correlations beyond gender. Race variables include White, African-American, Asian American, as well as an “other” race category that combines Native-American, Pacific-Islanders, and those who declined to respond. I create the “other” race category because of the low number of observations within this category. Table 5 summarizes the drops by race at SOI-East.

Table 5. SOI-East Injury Drops by Race

Injury Drop from SOI-East by Race			
Race	**Not Dropped**	**Dropped**	**Percent Dropped**
American Indian or Alaska Native	433	4	0.92%
Asian	1,723	26	1.49%
Black or African American	12,529	153	1.21%
Declined to Respond	482	10	2.03%
Native Hawaiian or Other Pacific Island	494	2	0.40%
White	58,277	1,179	1.98%
Total	73,938	1,374	1.82%

Family status demographics include a variable indicating whether a Marine is married or not married. A children variable exists to indicate the number of children dependent on a Marine. I include these variables to control for the stress having a family may add or reduce while in an infantry training environment.

b. *Marginal Effects of Policy Change*

In 2016, all jobs in the Marine Corps previously closed to females, opened. After this change, women were authorized to receive a combat arms MOS and if designated infantry, attend ITB. This policy change may affect the injury rates before and after the change. Because of this change, I analyze the marginal effects of the injury rates before and after the policy by gender. I use the same SOI-East data set. I use logistic regression and in addition to the previously described variables, I create an indicator of whether a Marine attended SOI before or after the policy. I also create a variable interacting the AFTER_POLICY indicator variable with FEMALE. This interaction allows accurate interpretation of the effect the policy had on each gender. I use the following equation for my logistic regression analysis:

$$\text{Pr(INJURY\_DROP)} = B_0 + B_1\text{*FEMALE} + B_2\text{*AFTER\_POLICY} + B_3\text{*FEMALE*AFTER\_POLICY} + B4\text{*PFT\_SCORE} + B_5\text{*CFT\_SCORE} + B_6\text{*GT\_SCORE} + B_7\text{*Race} + B_8\text{*Family Status} + \varepsilon$$

The variable INJURY_DROP includes Marines who may have dropped due to injury and then recycle to a follow-on class. Because of the ability to recycle, I subject my analysis to measurement error because a Marine may have dropped due to injury prior to the policy change then pass in a class after the policy change.

c. Marginal Effects of Physical Ability

Using the same logistic regression model previously described, I analyze the marginal effects that PFT and CFT scores have on the probability of injury drop by gender. By analyzing the marginal effects, I am able to estimate the effect each additional point scored in the respective physical test has on the probability of injury within a 95% confidence interval. In addition the FEMALE_AFTER_POLICY interaction, I interact the FEMALE variable with PFT_SCORE and CFT_SCORE.

$$\begin{gathered}\text{Pr(INJURY\_DROP)} = B_0 + B_1\text{*FEMALE} + B_2\text{*AFTER\_POLICY} + \\ B_3\text{*FEMALE*AFTER\_POLICY} + B_4\text{*FEMALE*PFT\_SCORE} + \\ B_5\text{*FEMALE*CFT\_SCORE} + B_6\text{*PFT\_SCORE} + B_7\text{*CFT\_SCORE} + B_8\text{*GT\_SCORE} + \\ B_9\text{*Race} + B_{10}\text{*Family Status} + \varepsilon\end{gathered}$$

The marginal effects of PFT and CFT scores assume that all other variables hold constant in the analysis.

d. Injury Drops Predicted by Initial Strength Test (IST)

My research questions included analyzing how well the IST, taken as a recruit before attending recruit training, predicts the likelihood of becoming an injury drop at MCT or ITB. The data for this remains limited to E1-E3 Marines at SOI-East; however, I exclude observations that chronologically took place prior to the implementation of the IST in FY2016. After exclusions, my data set shrinks to 23,664.

I use a logistic regression with an interaction between FEMALE and IST events, specifically the run time and the crunches. Male recruits run a distance of 1.5 miles and female recruits run a distance of 1 mile. I exclude IST crunches if score was recorded as zero as well as IST run times recorded as 0 or over 40 minutes as these are either administrative errors or extreme outliers that will cloud analysis. After these exclusions, my total observations decreases to 20,399. I do not analyze pull-ups, flexed arm hang, or push-ups because female recruits had a choice whether to conduct pull-ups, flexed arm hang, or both, and the number of observations with recorded push-ups (2,082) is not high enough to accurately use for analysis.

Figure 9. Distribution of IST Crunches at SOI-East

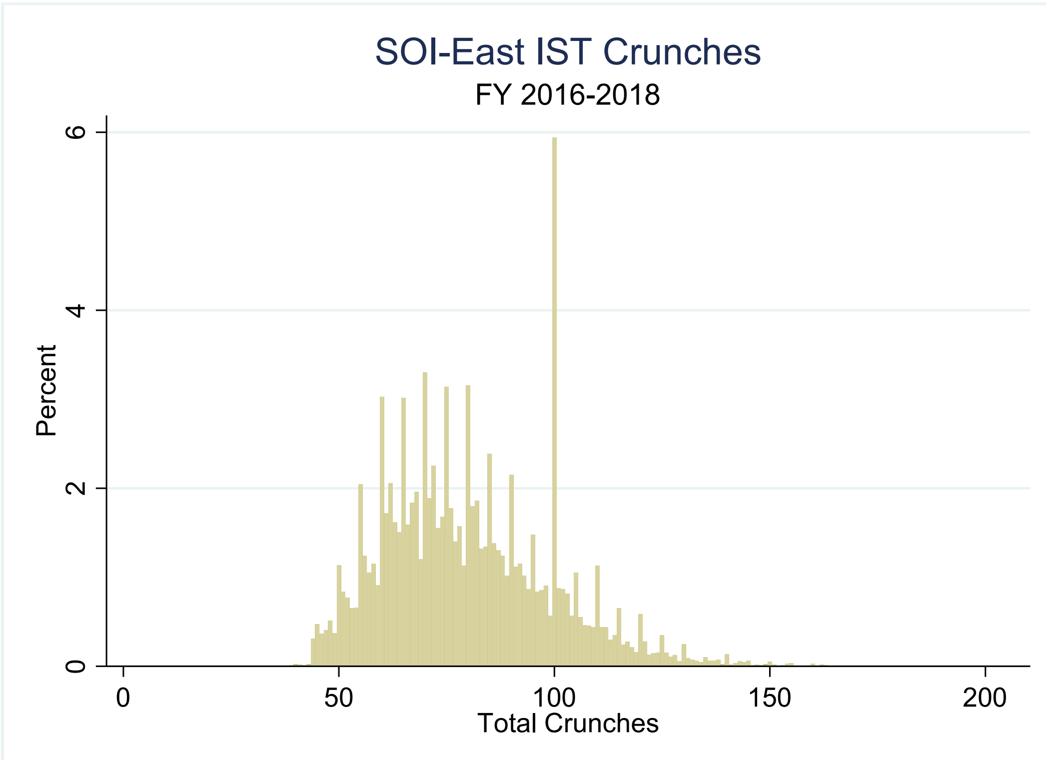
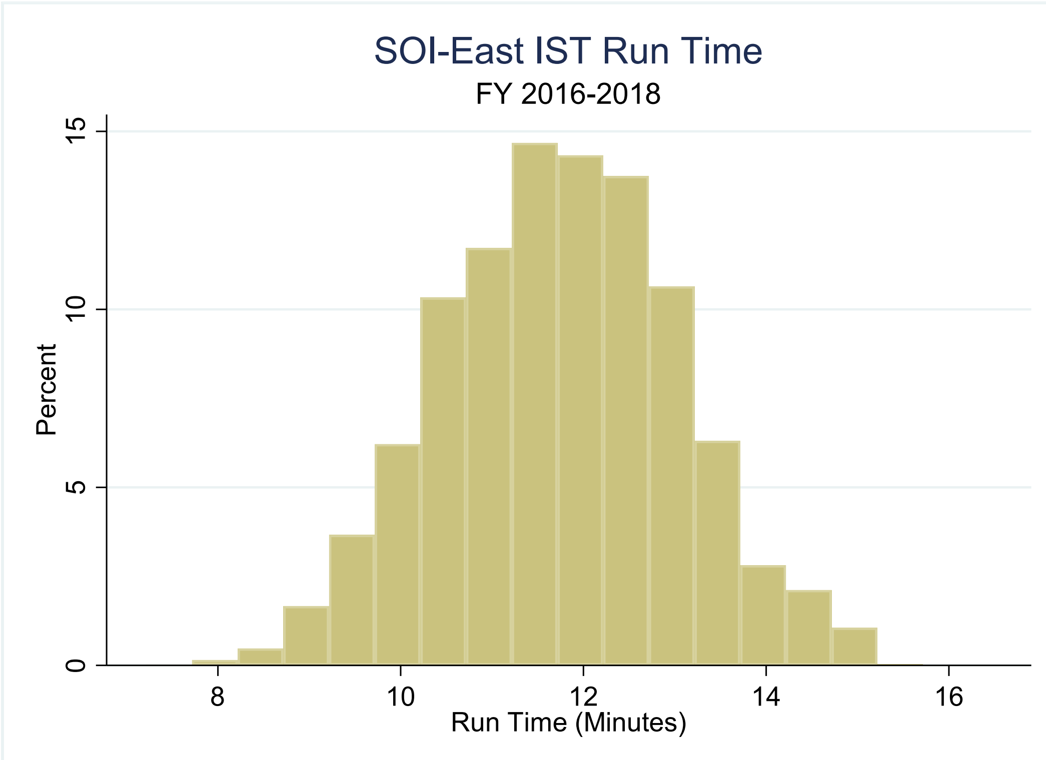


Figure 10. Distribution of 1.5 mile IST Run times at SOI-East



Using logistic modeling and then marginal effects, I analyze the probability of dropping due to injury based on IST scores and gender using the following equations:

$$\Pr(\text{INJURY\_DROP}) = B_0 + B_1*\text{FEMALE} + B_2*\text{IST\_CRUNCH} + B_3*\text{FEMALE}*\text{IST\_CRUNCH} + B_4*\text{GT\_SCORE} + B_5*\text{Race} + \mathcal{E}$$

$$\Pr(\text{INJURY\_DROP}) = B_0 + B_1*\text{FEMALE} + B_2*\text{IST\_RUN} + B_3*\text{FEMALE}*\text{IST\_RUN} + B_4*\text{GT\_SCORE} + B_5*\text{Race} + \mathcal{E}$$

2. Proficiency and Conduct Prediction

The effects on the Marine and the institution of dropping due to injury at SOI-East remain unclear. However, Marines dropped due to injury cost the Marine Corps additional money in medical costs and if recycled, they continue collecting benefits while waiting to attend another class. I attempt to uncover what value these Marines provide the Marine Corps throughout their careers through analysis of their average proficiency and conduct marks, which range from 0.0 to 5.0. TFDW collects these marks converted to a 0 to 50 scale through the Marine's career (grade E1-E5) and records it as an overall average. I convert these values to their conventional scale of 0.0 to 5.0. Using OLS analysis, I regress PRO_CON_AVG on INJURY_DROP, the average proficiency and conduct marks. I use the following model:

$$\text{PRO\_CON\_AVG} = B_0 + B_1 \text{*INJURY\_DROP} + B_2 \text{*PFT\_SCORE} + B_3 \text{*CFT\_SCORE} + B_4 \text{*GT\_SCORE} + \varepsilon$$

My model is subject to bias because not all Marines in the SOI-East sample of 75,312 had similar length careers, promotion rates, etc. Many policy changes occurred throughout the duration of my sample. Risk of reverse causality also exists. I assume most Marines receive low marks because of their inherent qualities such as motivation that may have caused their dropping due to injury; however, Marines who receive low marks may be dropped due to injury. This could be the case for underperforming Marines where the SOI Combat Instructors seek any means to drop Marines deemed unworthy to serve in operational units. I assume the percentage of Marines affected by this reverse causality remains low, but the risk of bias remains. These factors are likely to skew the data to unknown extents.

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V. RESULTS AND ANALYSIS

My results center on my research questions correlating dropping due to injury with gender differences, geographic differences, performance marks, and IST scores.

A. GENDER

1. Fiscal Years 2012–2018

After analyzing my data set of SOI-East Marines with a recorded SOI Status between the ranks of E1-E3, I find that gender correlates to injury drop with statistical significance. Table 6 shows the logistic regression model used with odds ratios and the standard errors. I use five separate equations of the same dependent variable adding control variables to account for any omitted variables bias. As shown, the female variable coefficient does not change significantly with additional controls indicating that it correlates strongly to injury drop. Holding all other factors constant, a female Marine in my data set is 2.74 times more likely to become an injury drop at SOI-East. However, when analyzing PFT and CFT scores with all other factors held constant the likelihood of becoming an injury drop decreases. A perfect score of 300 on a PFT makes a Marine 0.198 times as likely to become an injury drop and a perfect score of 300 on a CFT makes them 0.450 times as likely to become an injury drop when compared to a Marine who scores 0.

Table 6. SOI-East Logistic Regression Odds Ratios

	(1) Injury Drop from SOI	(2) Injury Drop from SOI	(3) Injury Drop from SOI	(4) Injury Drop from SOI	(5) Injury Drop from SOI
Gender Female=1	2.789***	2.822***	2.771***	2.737***	2.742***
	(0.155)	(0.159)	(0.161)	(0.159)	(0.160)
Physical Fitness Test Score 0–300		0.994***	0.994***	0.995***	0.995***
		(0.001)	(0.001)	(0.001)	(0.001)
Combat Fitness Test Score 0–300		0.997***	0.998***	0.997***	0.997***
		(0.001)	(0.001)	(0.001)	(0.001)
GT_SCORE			0.996	0.991***	0.991***
			(0.002)	(0.003)	(0.003)
Age in Years				1.027	1.029*
				(0.015)	(0.015)
Race African American = 1				0.576***	0.576***
				(0.053)	(0.053)
Race Asian American = 1				0.676	0.676
				(0.138)	(0.138)
OTHER_RACE				0.432**	0.431**
				(0.113)	(0.113)
Number of Children					1.302
					(0.431)
MARRIED					0.781
					(0.180)
Observations	75312	74092	73108	73108	73108
R^2					

Note: All values given in terms of odds ratio. Standard errors given in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

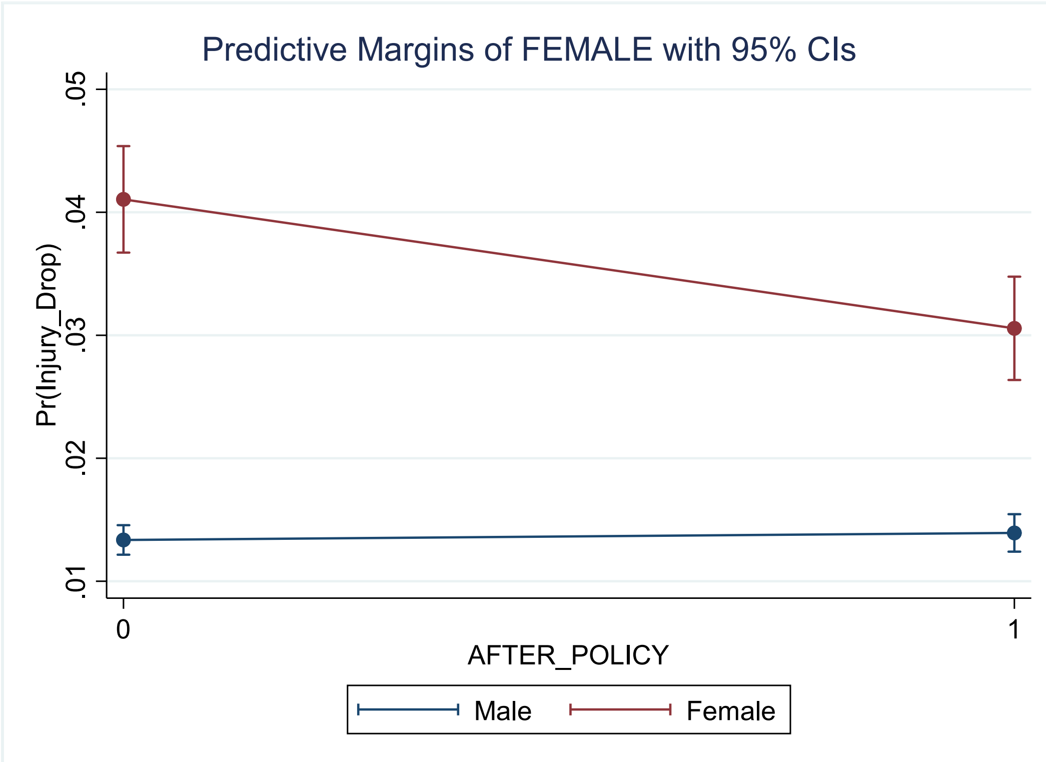
My observations vary between model run because of missing data within the additional variables. Understanding that my SOI-East data excludes many observations for administrative errors, I still find that women are more likely to drop due to injury at SOI-

East because of the statistical significance within my model. This risk of injury drop can be mitigated through high levels of physical fitness as shown by the results of PFT and CFT scores. Only 11.1% of my sample consists of female Marines. It is likely that all results are biased by the male observations thus making the overall chance of dropping due to injury inconclusive.

2. Marginal Effects of the Gender Integration Policy

Because of the gender integration policy changes in 2016, I use the same SOI-East sample to analyze the effects the policy change had on injury drops related to gender. Figure 11 illustrates the logistic regression results with the marginal effects of before and after the gender integration policy change. After the policy females decrease their probability of becoming an injury drop with statistical significance. Before the policy a female Marine possesses a 4.11% chance of injury drop; after the gender integration policy implementation, a female Marine possesses a 3.06% chance of injury drop. Male Marines do not have significant differences in chance of injury drop maintaining a statistically significant chance of dropping between 1.34% and 1.39% chance of injury drop.

Figure 11. Logistic Regression Marginal Effects of Policy Change by Gender



3. Marginal Effects of PFT and CFT Score

As found in the first logistic regression model, physical fitness negatively correlates to injury drop. Figures 12 and 13 illustrate the how scores on PFT and CFT affect the probability of dropping due to injury. As shown, the more physically fit a Marine is, the less likely injury drop becomes. Between the genders, males possess less deviation in probability of dropping regardless of PFT or CFT score compared to females. Overall, women who score higher on physical fitness tests decrease their chances of injury drop by approximately 50%. These results are like previous results in that they subject themselves to bias from the small number of women within the sample and the large number of exclusions due to administrative errors.

Figure 12. Logistical Regression Marginal Effects of PFT Score by Gender

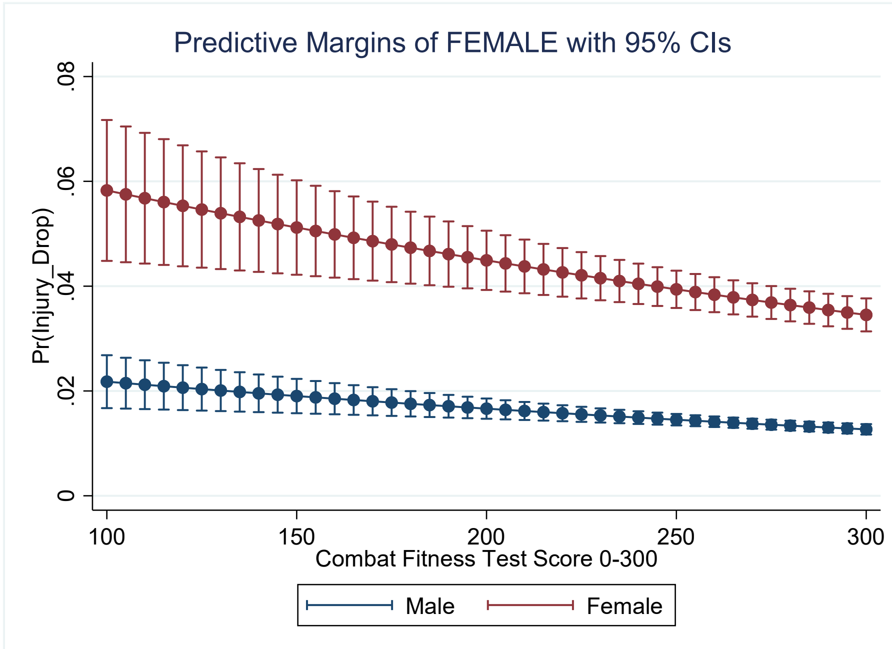
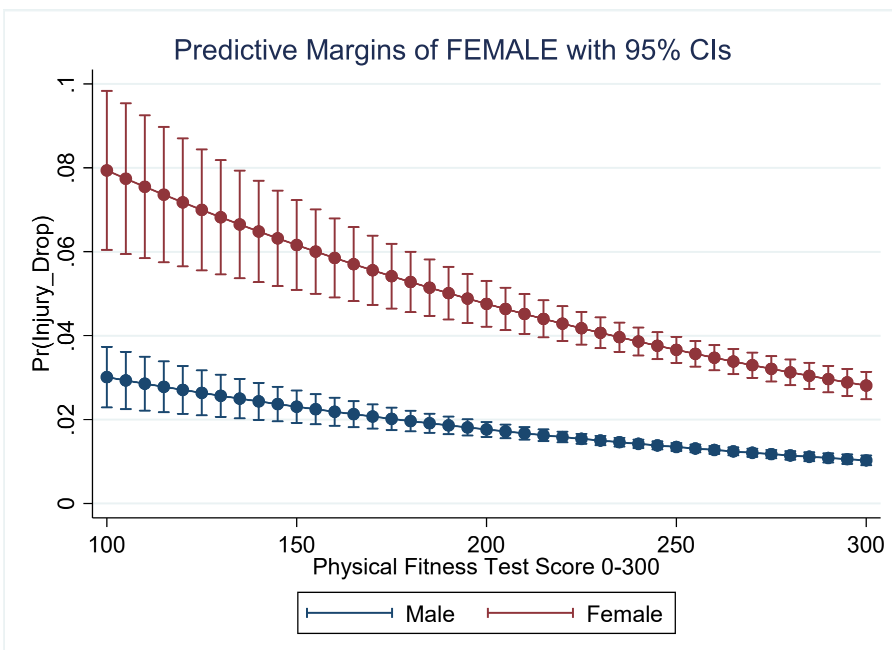


Figure 13. Logistical Regression Marginal Effects of CFT Score by Gender



B. GEOGRAPHIC DIFFERENCES

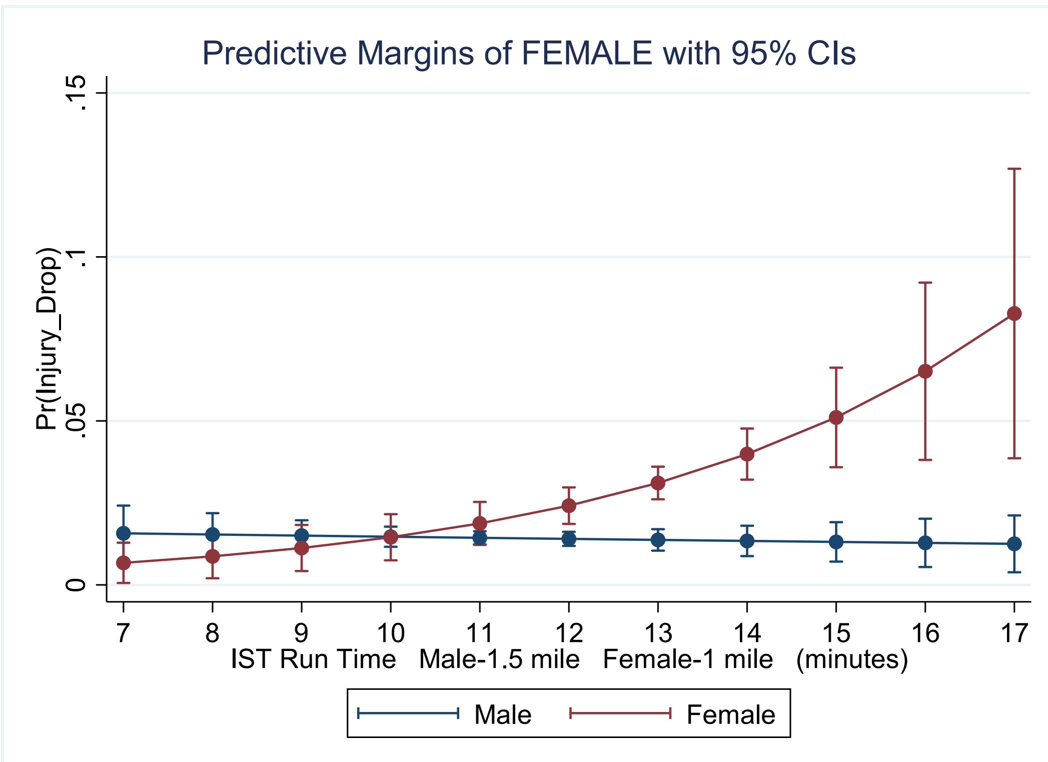
Because of my data limitations previously described, regression analysis of geographical differences in injury drops is not feasible. However, comparing the summary statistics of my data between the two locations, SOI-East sustains a higher rate of injury drops than SOI-West, as shown in Figure 6 on page 32. SOI-East dropped 1,374 Marines due to injury within the sample, and SOI-West dropped 105 Marines due to injury within the sample. Any cause for the differences outside of this summary statistic remains speculative.

In support of my research, the Navy EpiData Center Department provided aggregate statistics of Marines' injuries from 2016–2018 (after the policy implementation) at ITB and MCT. Instead of using injury drop, their data includes reported injuries through the Navy medical reporting system; these observations did not necessarily drop due to injury, but rather sought diagnosis and treatment for a sustained injury. Their results show differences in body location of injury as well as injury type. Specifically, SOI-West sustains a much higher rate of injury to the lower leg and ankle as well as a much higher rate of sprains and strains. This may be caused by the topographical differences between the locations; SOI-East training on relatively flat and swamp like terrain and SOI-West steep and rocky terrain. Section I of the appendices provides the detailed report from the EpiData Center Department.

C. INITIAL STRENGTH TEST CORRELATION TO INJURY DROPS

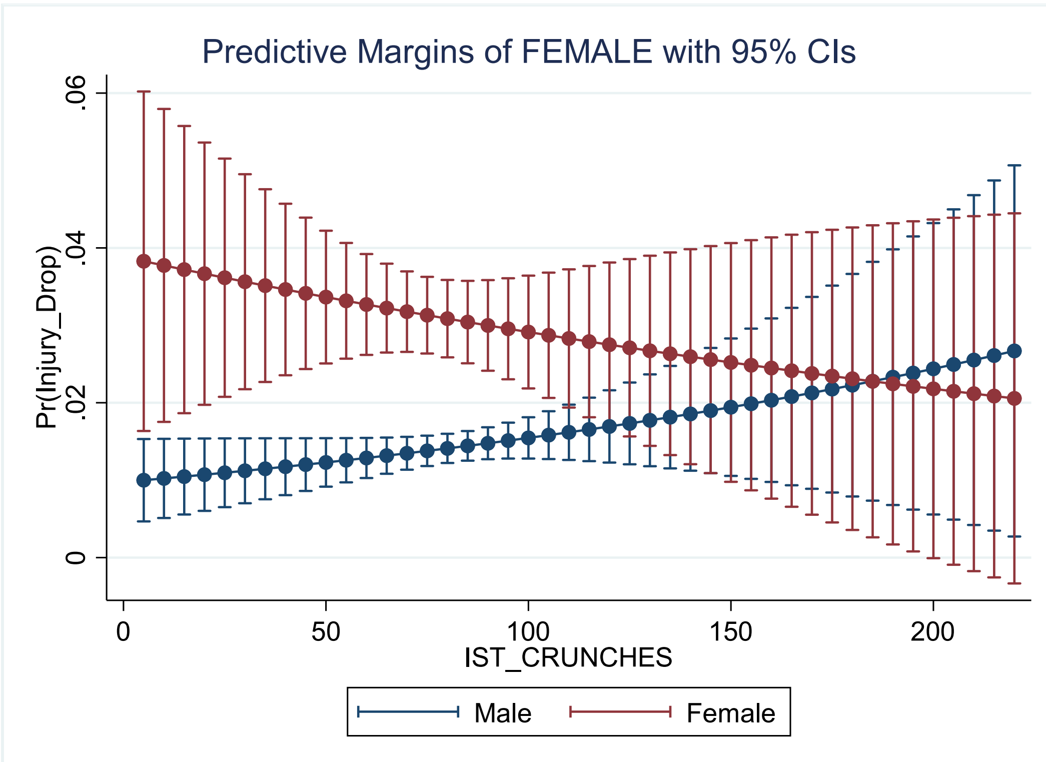
Along with the gender integration policy, the Marine Corps Recruiting Command started using the IST with civilian recruits to measure physical ability prior to attending recruit training. Using the same SOI-East sample excluding observations before the IST implementation, I analyze the extent to which two IST events, crunches and run time, correlate to injury drops at SOI-East. Males run 1.5 miles; females run 1 mile. Based on the logistic regression and its marginal effects shown in Figure 14, male Marine recruits' IST run times do not significantly affect the probability of injury drop at SOI-East. Conversely, female Marine recruits' probability of injury drop positively correlates to their run time. If a female runs 1 mile in less than 10 minutes, they are less likely to drop due to injury at SOI-East compared to a male of equivalent run time (who ran 1.5 miles), holding all other factors constant. Within my sample, only 56 of the 4,999 females in the IST sample ran their IST 1.5 miles in less than 10 minutes. The primary takeaway from Figure 14 is that women, who run less than a 10-minute mile, are less likely to drop at SOI than a male who runs 1.5 miles in less than 10 minutes. If a female runs a slower time, their probability of injury drop is greater than a male of the same time on their 1.5-mile run holding all other factors constant.

Figure 14. Logistical Regression Marginal Effects of IST 1.5 Mile Run Time by Gender



I analyze IST crunches in the same manner as the run, logistical regression marginal effects. I find that females' crunches negatively correlate to injury drop and that males' crunches positively correlate to injury drop holding all other factors constant. These values are statistically significant. Regardless of the correlation trend, males maintain a probability of injury drop less than 3% and females maintain a probability of injury drop less than 4% based on IST crunches holding all other factors constant. Figure 15 illustrates these results.

Figure 15. Logistical Regression Marginal Effects of IST Crunches by Gender



D. PERFORMANCE MARKS RELATED TO INJURY

Proficiency and Conduct marks negatively correlate to dropping due to injury at SOI-East. Table 6 shows the results of the OLS predictive model. Holding all other variables constant within the SOI-East sample, a Marine who drops due to injury averages 0.12 points lower on proficiency and conduct marks for their entire time in service compared to a Marine who does not drop due to injury. When controlling for a Marine's PFT score, CFT score, and GT score, the values in Table 6 account for a one-point change. As shown in Table 4 on page 31, the average PFT score within my data is 253.04, CFT is 279.32, and the average GT score is 107.95. Therefore, a Marine who scores a 250 on their annual PFT also possesses an additional 0.25 points in average proficiency and conduct marks within my model and holding all other factors constant. These results suffer the same administrative error bias previously described along with measurement error bias. The measurement error arises from Marines within the sample not having equivalent time in service.

Table 7. OLS Regression of Proficiency and Conduct on Injury Drop

	(1)
	Average Pro and Con Marks for Time in Service
Injury Drop from SOI	-0.117^{***}
	(0.005)
Physical Fitness Test Score 0–300	0.001^{***}
	(0.000)
Combat Fitness Test Score 0–300	0.000^{***}
	(0.000)
GT_SCORE	0.001^{***}
	(0.000)
Constant	3.824^{***}
	(0.008)
Observations	73020
R^2	0.057

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

E. SUMMARY

Using the TFDW and SOI-East Sports Trainer data provided, I answer my primary question of gender differences as related to attrition due to injury and my secondary questions of GCA-IST and performance marks as they relate to attrition due to injury. I find that females probability of dropping due to injury is greater than males. Female recruits who score high on their IST run and crunch events decrease the probability of dropping due to injury upon attending MCT or ITB. I find that dropping due to injury at MCT or ITB negatively correlates to proficiency and conduct marks. The second primary question of differences injury based on training location could not be answered using the TFDW and SOI-East Sports Trainer data, but using the aggregate statistics provided by the EpiData Center I find that MCT at both locations does not significantly differ as related to reported injuries. However, ITB experiences different quantities of reported injuries to the lower leg and ankle. All of my results likely suffer bias as described and until errors improve within the Marine Corps' data collection, further analysis would likely yield similar results.

VI. CONCLUSIONS AND RECOMMENDATIONS

My research focuses on determining if correlations exist among gender, geography, recruit physical ability, performance, and dropping due to injury at SOI-East. By finding correlations between these factors and dropping due to injury at SOI-East, the Marine Corps' leadership can take informed steps towards risk mitigation and recruit characteristics. Because my data has a significant portion lacking details on the status of students at SOI, I believe my results are positively biased. I believe that the injury rates found in this research are higher than what really exists; however, I do believe that my analysis is correct that females drop due to injury at a higher rate than males. The extent to which they differ would likely decrease with more accurate data.

A. CONCLUSIONS

When analyzing correlations between gender and injury drop, I find that a difference does exist between the rates of males and females. Females sustain injury drops at a higher rate than males. Comparing the genders before and after the gender integration policy change, females maintain a higher rate of injury drop, but decrease their rate by over a percentage point. I suspect the results of the GCE Integrated Task Force showing that females attrited at higher rates contributed to a change in training techniques at SOI that reduce the probability of dropping due to injury.

Though females maintain a higher injury drop rate, controlling for their physical fitness proved to correlate to reduced probability of injury drop. As females PFT and CFT scores increase, their probability of injury drop decrease as shown in Figures 13 and 14. This makes sense as physically fit individuals likely accomplish the demands of MCT and ITB with less effort than those of less ability. With the Marine Corps changing the physical standards for both genders, I suspect a shift in this correlation as higher physical standards could cause either lower or higher rates of injury depending on the physiological theory applied. If the Marine Corps standardizes the physical tests across both genders, using my methods of analysis may yield ambiguous results because the effects of male scores, over 90% of the Marine Corps' composition, will likely bias the overall results of analysis.

After analyzing recruits' IST scores correlation to injury drop at SOI-East, I find that female recruits' physical ability serves as a better predictor for injury drop than males. The more crunches or faster a female recruit is capable of negatively correlates to their probability of dropping due to injury at SOI-East. Conversely, I find male recruits' physical abilities inconclusive in determining the probability of injury drop. Because the IST started implementation in 2016, my observations may not be sufficient for accurate analysis. With more time, analysis of the IST's predictive accuracy of injury drop may improve.

My results of dropping due to injury at SOI-East affecting a Marine's average proficiency and conduct marks yielded a difference of 0.13 points between an injury drop and a Marine who did not drop due to injury. Because of previously explained biases, I find my results inconclusive. If given proficiency and conduct marks by grade, I could analyze the correlation more accurately.

Despite exclusions due to administrative errors, I find results similar to previous studies. My logistic regression resulting in females being 2.74 times more likely to drop due to injury than a male mimics the results of the Naval Academy ACL study that concludes females are 2.44 times more likely to sustain an ACL injury than males, (Gwinn, Wilckens, Mcdevitt, Ross, Kao, 2000). In the West Point study, females were 1.51 times more likely than males to sustain ACL injuries, (Mountcastle, Posner, Kragh, & Taylor, 2007). The Appalachian Trail study revealed women abandon their hiking goals at higher rates than men and slightly differ in rates of abandonment due to injury. Though my data lacks desired level of detail, it follows the trend of previous studies.

Marines dropping for injury affects the Marine Corps' readiness and costs additional taxpayer money through medical costs, salary to the injured Marine, or lost investment by separation from the Marine Corps. Steps should continue to be taken to recruit individuals less likely to sustain injuries at MCT or ITB as well as mitigate the risks of injury at SOI.

B. RECOMMENDATIONS

Data for my analysis lacked details needed for accurate analysis. The largest problem lies with the Marine Corps' lack of injury tracking. The Marine Corps lacks a system that links to TFDW and tracks injuries in a standardized format. With a system capable of injury tracking, detailed analysis of trends in injury is possible.

Along with injury tracking, administrative errors within each Marine's SOI status cause high probability of analysis bias. 59,333 observations were dropped from my analysis because of a lack of status at SOI. To remediate this problem, SOI students should receive a status upon check in at their appropriate course. Minimizing this missing data would greatly enhance the analysis of SOI Marines.

Distinguishing students between the courses conducted at SOI was not possible within my research. TFDW lacks a way to break out what course a Marine attends at SOI (MCT, ITB, etc.). Without this information, I am unable to analyze the difference in injuries between genders at MCT or ITB individually without supplemental data from the SOI schoolhouses. The Marine Corps should enhance its detailed data collection to allow analysis that is more specific.

Overall, the Marine Corps' data collection needs improvement in standardization and compilation. TFDW lacks specific data related to training and does not standardize aspects of data collected. To improve analysis, first data collection needs improved.

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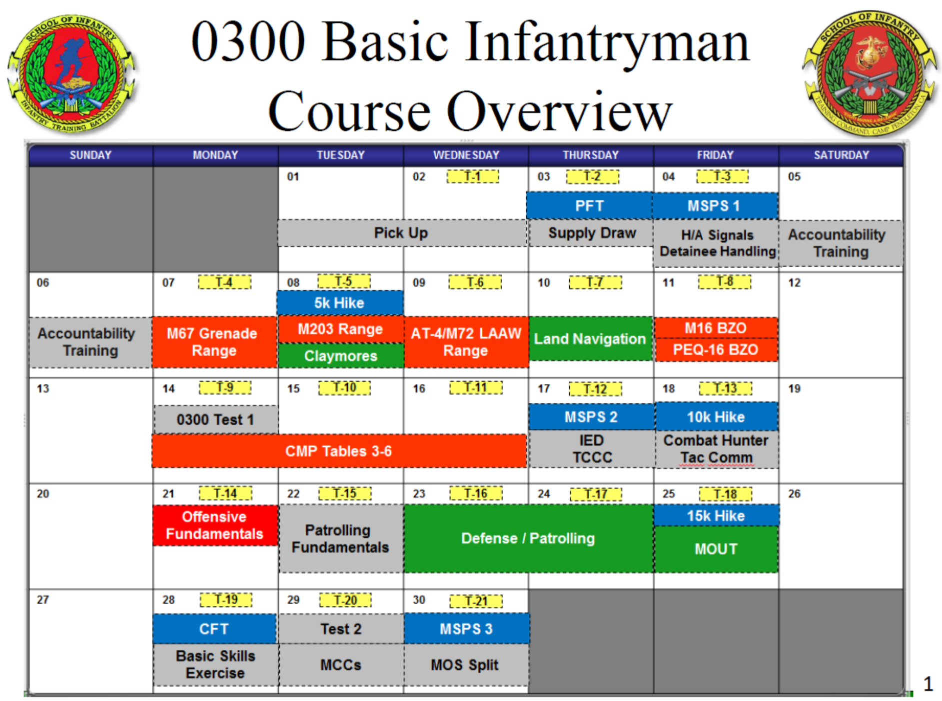
APPENDIX

A. ENLISTED MOS ENTRY-LEVEL TRAINING

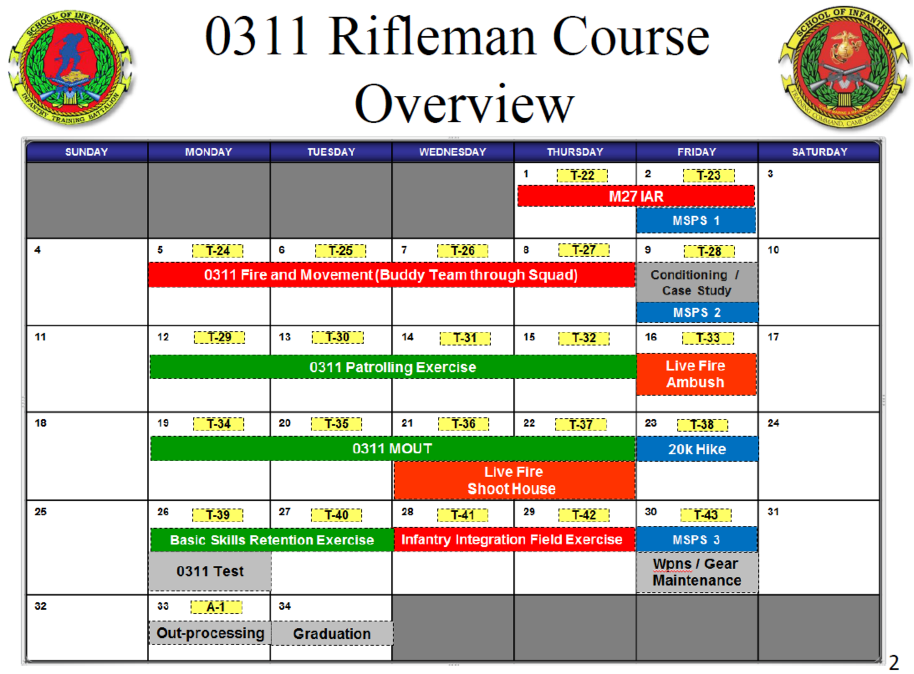


SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		01 Pick Up	02 T-1	03 T-2 PFT Supply Draw	04 T-3 MSPS 1 H/A Signals Detainee Handling	05 Accountability Training
06 Accountability Training	07 T-4 M67 Grenade Range	08 T-5 5k Hike M203 Range Claymores	09 T-6 AT-4/M72 LAAW Range	10 T-7 Land Navigation	11 T-8 M16 BZO PEQ-16 BZO	12
13	14 T-9 0300 Test 1 CMP Tables 3-6	15 T-10	16 T-11	17 T-12 MSPS 2 IED TCCC	18 T-13 10k Hike Combat Hunter Tac Comm	19
20	21 T-14 Offensive Fundamentals	22 T-15 Patrolling Fundamentals	23 T-16 Defense / Patrolling	24 T-17	25 T-18 15k Hike MOUT	26
27	28 T-19 CFT Basic Skills Exercise	29 T-20 Test 2 MCCs	30 T-21 MSPS 3 MOS Split			

1

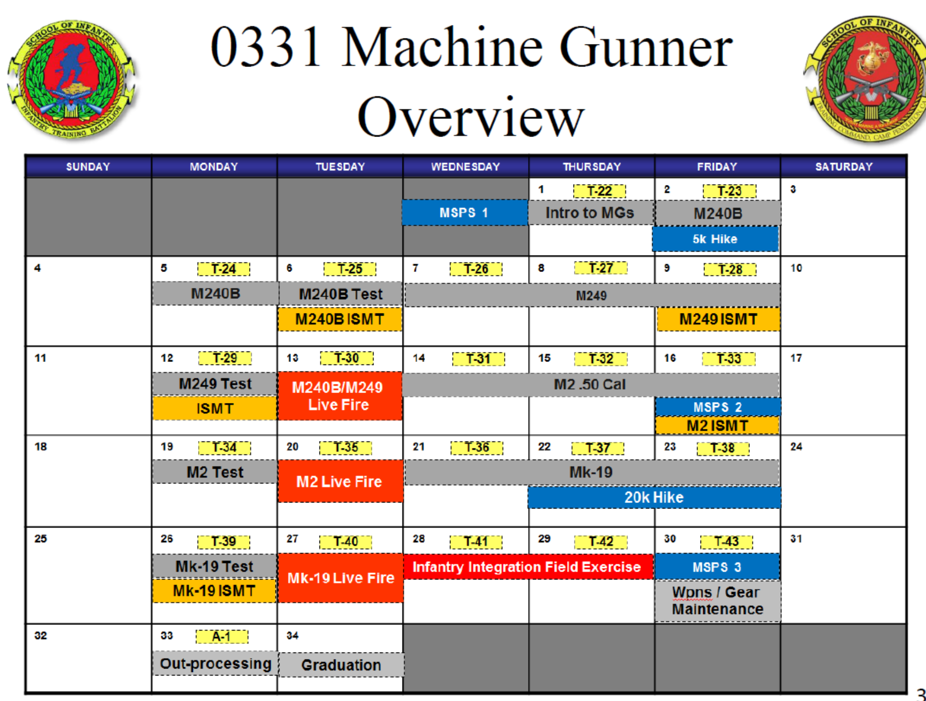
Source: ITB (n.d.).

B. 0311 RIFLEMAN POI



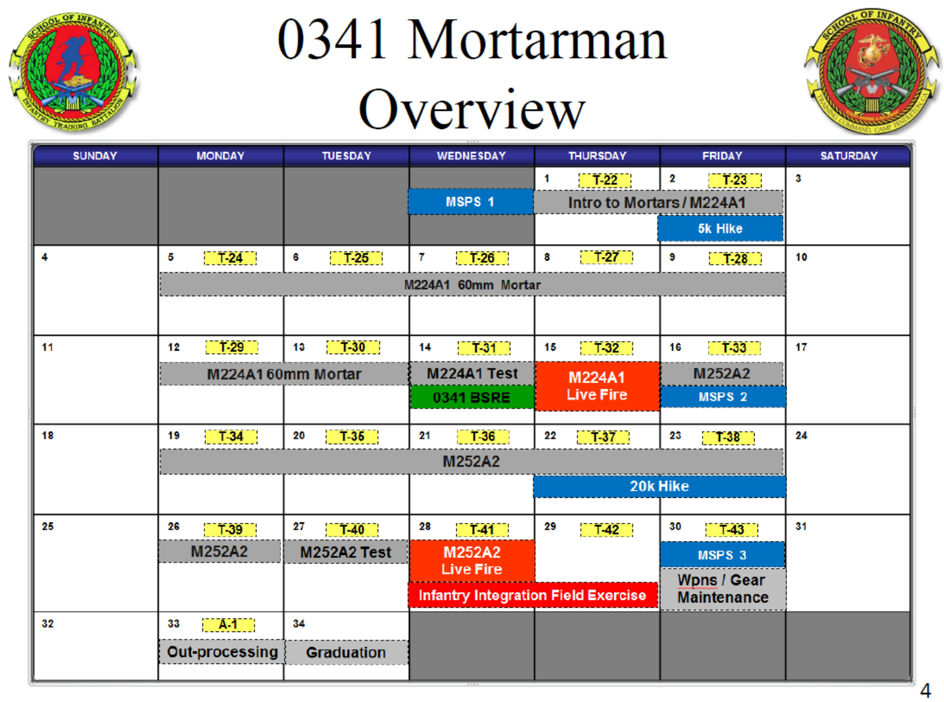
Source: ITB (n.d.).

C. 0331 MACHINEGUNNER POI



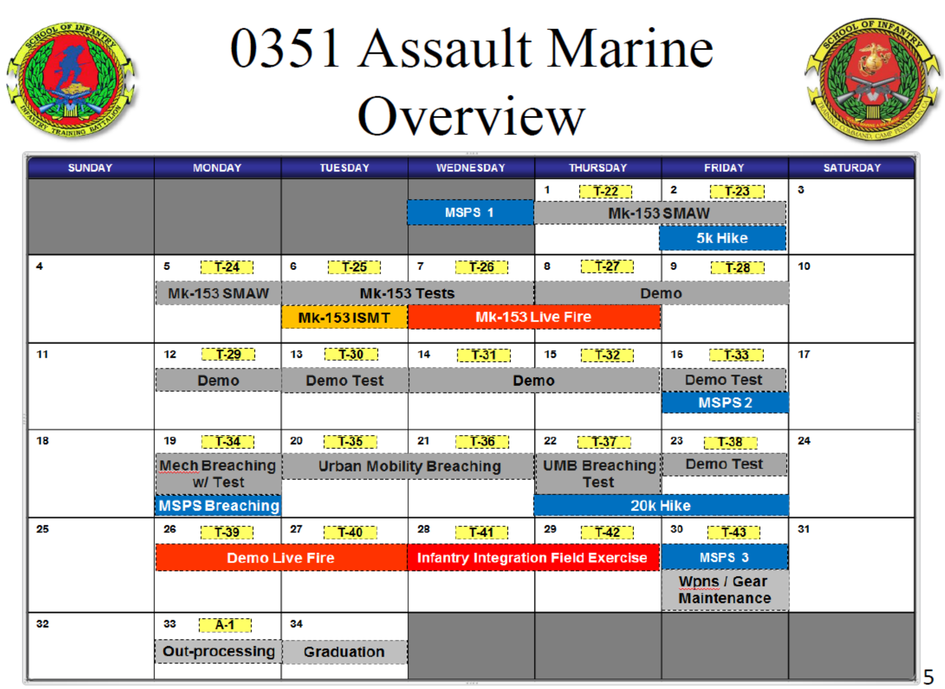
Source: ITB (n.d.).

D. 0341 MORTARMAN POI



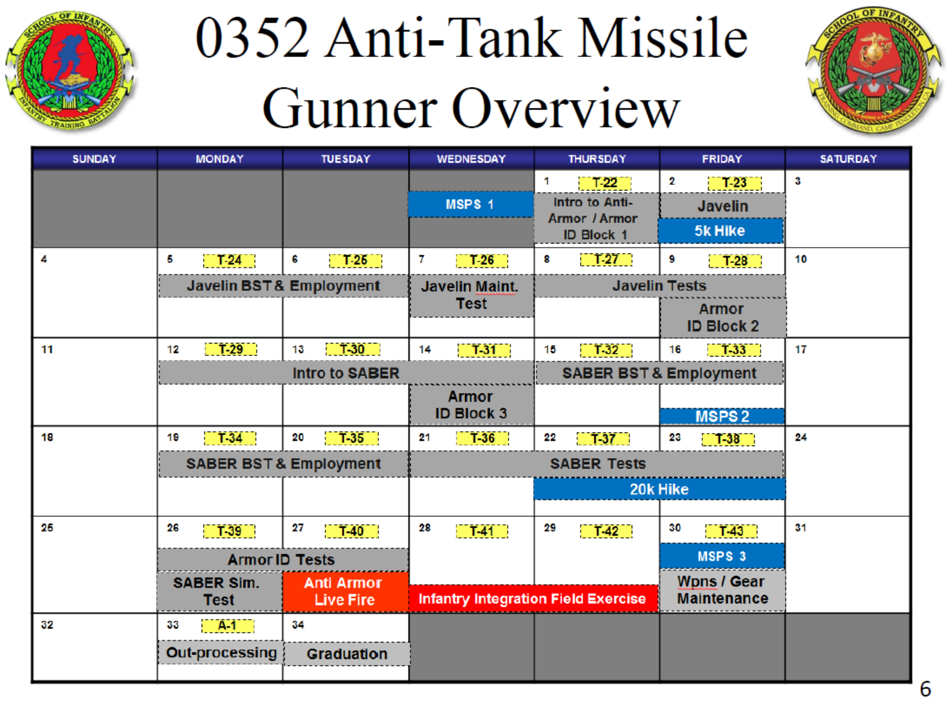
Source: ITB (n.d.).

E. 0351 ASSAULTMAN POI



Source: ITB (n.d.).

F. 0352 ASSAULTMAN POI



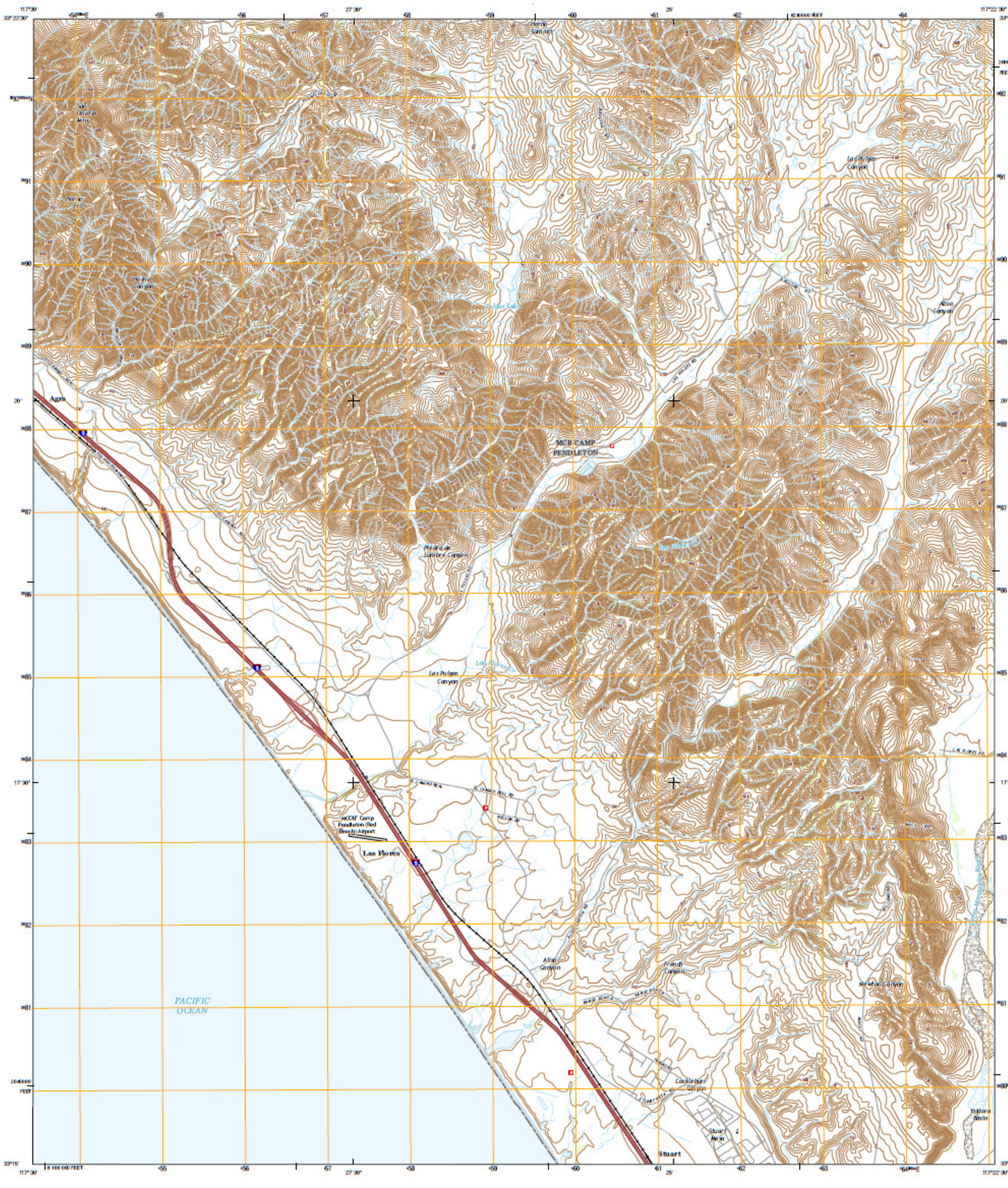
0352 Anti-Tank Missile Gunner Overview

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			MSPS 1	1 T-22 Intro to Anti-Armor / Armor ID Block 1	2 T-23 Javelin 5k Hike	3
4	5 T-24 Javelin BST & Employment	6 T-25	7 T-26 Javelin Maint. Test	8 T-27 Javelin Tests	9 T-28 Armor ID Block 2	10
11	12 T-29 Intro to SABER	13 T-30	14 T-31 Armor ID Block 3	15 T-32 SABER BST & Employment	16 T-33 MSPS 2	17
18	19 T-34 SABER BST & Employment	20 T-35	21 T-36 SABER Tests	22 T-37 20k Hike	23 T-38	24
25	26 T-39 Armor ID Tests SABER Sim. Test	27 T-40 Anti Armor Live Fire	28 T-41 Infantry Integration Field Exercise	29 T-42	30 T-43 MSPS 3 Wpns / Gear Maintenance	31
32	33 A-1 Out-processing	34 Graduation				

6

Source: ITB (n.d.).

G. TOPOGRAPHIC MAP OF CAMP PENDLETON



Source: USGS (2015).

H. TOPOGRAPHIC MAP OF CAMP LEJEUNE

Source: USGS (2016).

I. EPIDATA CENTER AGGREGATE INJURY STATISTICS OF MCT AND ITB

USMC School of Infantry Injuries, January 2016-November 2018
Prepared February 2019
EpiData Center Department
NMCPHC-EDC-TR-111-2019

United States Marine Corps, School of Infantry Injuries, January 2016 through November 2018

Background

The Navy and Marine Corps Public Health Center (NMCPHC) EpiData Center (EDC) Department was tasked in January 2019 by Captain Zachary Basich of the Naval Postgraduate School to analyze injury data from January 2016 through November 2018 using personnel and medical encounter data. This report provides information on acute injuries among AD Marines in the School of Infantry (SOI); this analysis does not include chronic injuries or injuries due to cumulative microtrauma, e.g. overuse injuries.

The injury analyses included in this report are based on medical encounter data rather than unit mishap report data. Injury analyses of medical encounters, while lacking in causative information found in unit mishap reports, provide a practical estimate of the burden of injuries on operational readiness and the Military Health System (MHS). Unit mishap reports are more likely to capture serious injuries to include injuries that occur on the jobsite or due to vehicular accidents; however, they are known to underreport less serious injuries and injuries that occur away from the jobsite. Therefore, the injury rates in this report are not directly comparable to the injury rates derived through the mishap reporting system.

Methods

Roster data was obtained from the Defense Manpower Data Center (DMDC) AD monthly personnel rosters for Marine Corps service members (SMs) with an assigned reporting unit code (RUC) for a SOI in the months between January 2016 and November 2018.

Medical encounter records related to acute injuries from January 2016 through November 2018 were obtained from fixed military treatment facilities (MTFs). These records were broadly identified by selecting encounters with an International Classification of Disease-10th Revision-Clinical Modification (ICD-10-CM) code within the range of S00 to T88 for acute injuries. Encounter data from fixed MTFs were obtained from the Standard Inpatient Data Record (SIDR) and the Comprehensive Ambulatory/Professional Encounter Record (CAPER).

The Injury Disease Matrix (IDM) is used to classify injuries into one of thirty-six body regions and one of nineteen nature of injury categories, or injury types, based on ICD-10-CM codes within medical encounters. To identify all relevant acute injuries, ICD-10-CM diagnosis codes from the

Source: EpiData Center (2019).

USMC School of Infantry Injuries, January 2016-November 2018
Prepared February 2019
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medical encounter records were categorized into IDM "cells," unique combinations of the body region and injury type categories (e.g. knee + burns, knee + fracture, systemwide + poisoning). To avoid counting the same injury multiple times, any medical encounters for a SM categorized into the same IDM cell occurring within 60 days of a previous record were not counted as a new event, a gap in care rule consistent with analyses performed by the Army Public Health Center (APHC). Medical records categorized into the same IDM cell identified after 60 days of the most recent record were considered a unique injury event for that SM. . ICD-10-CM coding practices use a seventh character code of "S" to indicate medical encounters for conditions that are sequelae for a given injury; all sequelae conditions were excluded from the IDM.

This analysis contains an exception to the 60-day gap in care rule that should be noted. Amputations and traumatic brain injury (TBI) were only counted once per person per IDM cell per fiscal year. That is, if a SM had both a TBI with a fracture (TBI + fracture) and a TBI with nerve injury (TBI + nerve) during the fiscal year, that SM would have contributed to the TBI injury count twice during the fiscal year. However, if a SM had multiple TBI with brain injury (TBI + internal organ injury) during the fiscal year, only one TBI injury would be counted for that SM.

Demographic and occupational information was obtained by matching acute injury cases identified from the medical encounter data to DMDC AD monthly personnel rosters for the months between January 2016 and November 2018 where each SM was assigned a reporting unit code (RUC) that corresponded with a SOI training location. The occupational code to which the SM was attached at the time of injury was used to categorize acute injuries by either Infantry Training Battalion (ITB) or Marine Combat Training (MCT). Incident injury dates that could not be matched to the DMDC monthly roster and incident injuries that were matched to the DMDC monthly roster but were missing an occupational code were excluded from the analysis.

Acute injury proportions were calculated by dividing the total number of identified acute injury cases by the total number of SMs for the population in question (e.g. all AD Marines at MCT West, all male AD Marines at MCT East, etc.) and multiplying by 1,000 in order to obtain an interpretable value.

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Source: EpiData Center (2019).

USMC School of Infantry Injuries, January 2016-November 2018
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Results

Table 1 presents the injury counts for MCT and ITB by gender and training school location. For MCT, there were a total of 2,197 acute injuries that occurred between January 2016 and November 2018, among all Marines who attended MCT during that time frame. A total of 21,703 Marines attended ITB between January 2016 and November 2018; For ITB, there were a total of 1,810 acute injuries that occurred between January 2016 and November 2018, among all Marines who attended ITB during that time frame.

Table 1. Injury Counts among Active Duty Marine Corps Service Members Assigned to Marine Combat Training (MCT) or Infantry Training Battalion (ITB), by Gender and Training School Location, January 2016 to November 2018 (n=52,789 MCT, n=21,703 ITB)

MCT	Female	Male	Total
East	550	782	**1,332**
West	81	784	**865**
Total	**631**	**1,566**	**2,197**
ITB			
East	9	712	**721**
West	3	1,086	**1,089**
Total	**12**	**1,798**	**1,810**
Total	**643**	**3,364**	**4,007**

Data Sources: Standard Inpatient Data Record (SIDR), Comprehensive Ambulatory Professional Encounter Record (CAPER)
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center on 26 February 2019.

Figures 1-4 show the top ten injury body regions and injury types for MCT and ITB schools between January 2016 and November 2018. These metrics represent the proportion of individual acute injuries per 1,000 AD Marines at each MCT or ITB training school, not individual injured service members. A service member who sustained multiple acute injuries would be included in the proportion for each injury sustained.

Figure 1 shows the top ten injury body regions among AD Marines injured at MCT, by training school location. Lower leg and ankle injuries had the highest proportion for both the East and West MCT training schools at 9.0 and 10.5 injuries per 1,000 MCT Marines, respectively. The East MCT training school had higher proportions of injuries for all locations except lower leg and ankle and foot and toe injuries.

Source: EpiData Center (2019).

USMC School of Infantry Injuries, January 2016-November 2018
Prepared February 2019
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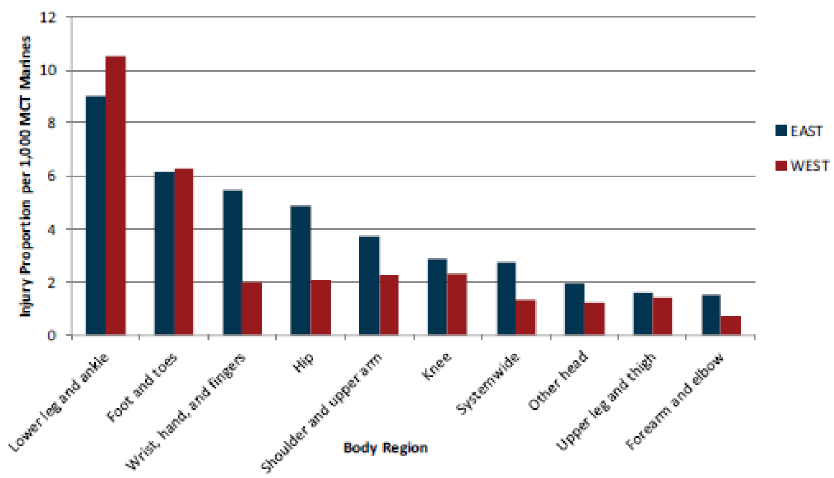
NMCPHC-EDC-TR-111-2019

Figure 1. Top Ten Injured Body Regions among Active Duty Marine Corps Service Members at Marine Combat Training (MCT), by School Location, January 2016 to November 2018 (n=28,308 East, n=24,508 West)



Data Source: Standard Inpatient Data Record (SIDR), Comprehensive Ambulatory Professional Encounter Record (CAPER)
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center on 26 February 2019.

Figure 2 shows the top ten injury types among AD Marines injured at MCT, by training school location. Sprains and strains had the highest proportion for both the East and West MCT training schools at 18.8 and 16.8 injuries per 1,000 MCT Marines, respectively. The East MCT training school had higher proportions of injuries for all types.

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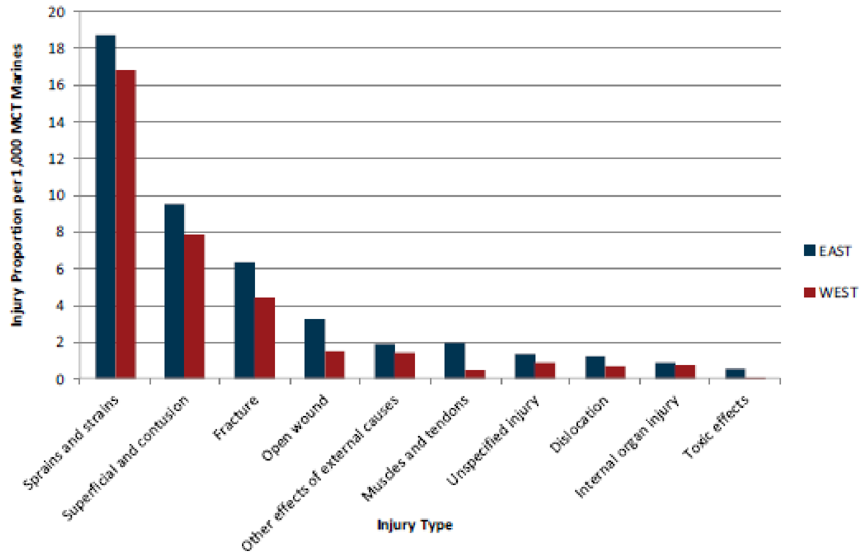
Source: EpiData Center (2019).

USMC School of Infantry Injuries, January 2016-November 2018
Prepared February 2019
EpiData Center Department
NMCPHC-EDC-TR-111-2019

Figure 2. Top Ten Injury Types among Active Duty Marine Corps Service Members at Marine Combat Training (MCT), by School Location, January 2016 to November 2018 (n=28,308 East, n=24,508 West)



Data Source: Standard Inpatient Data Record (SIDR), Comprehensive Ambulatory Professional Encounter Record (CAPER)
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center on 26 February 2019.

Figure 3 shows the top ten injury body regions among AD Marines injured at ITB, by training school location. Lower leg and ankle injuries had the highest proportion for the West ITB training school (24.7 injuries per 1,000 ITB Marines), while wrist, hand, and finger injuries had the highest proportion for the East ITB training school (12.6 injuries per 1,000 ITB Marines).

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Source: EpiData Center (2019).

USMC School of Infantry Injuries, January 2016-November 2018
Prepared February 2019
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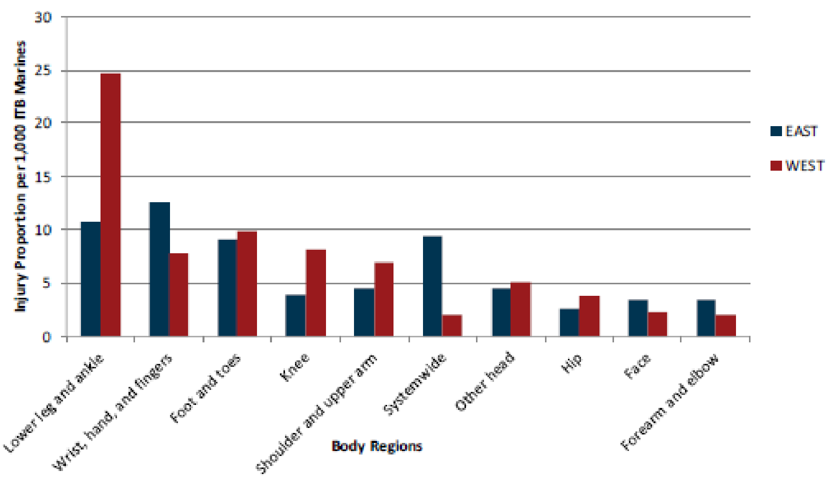
Figure 3. Top Ten Injured Body Regions among Active Duty Marine Corps Service Members at Infantry Training Battalion (ITB), by School Location, January 2016 to November 2018 (n=9,753 East, n=12,300 West)



Data Source: Standard Inpatient Data Record (SIDR), Comprehensive Ambulatory Professional Encounter Record (CAPER)
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center on 26 February 2019.

Figure 4 shows the top ten injury types among AD Marines injured at ITB, by training school location. Sprains and strains had the highest proportion for the West ITB training school (43.0 per 1,000 ITB Marines), while sprains and strains and superficial and contusion injuries had the highest proportion for the East ITB training school (17.0 per 1,000 ITB Marines each).

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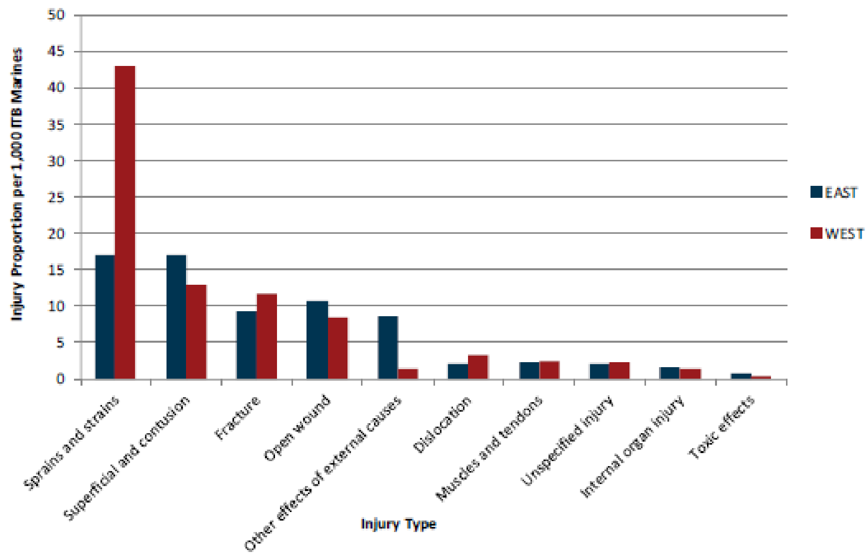
Source: EpiData Center (2019).

USMC School of Infantry Injuries, January 2016-November 2018
Prepared February 2019
EpiData Center Department
NMCPHC-EDC-TR-111-2019

Figure 4. Top Ten Injury Types among Active Duty Marine Corps Service Members Injured at Infantry Training Battalion (ITB), by School Location, January 2016 to November 2018 (n=9,753 East, n=12,300 West)



Data Source: Standard Inpatient Data Record (SIDR), Comprehensive Ambulatory Professional Encounter Record (CAPER)
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center on 26 February 2019.

Tables 2 and 3 present the injury counts and proportions for MCT and ITB by gender for body regions.

Table 2 shows that he highest proportion of injuries at MCT for males occurred in the body regions of lower leg and ankle, foot and toes, and wrist, hand, and fingers (8.1, 5.4, and 3.6 injuries per 1,000 male Marines at MCT, respectively), while the highest proportion of injuries for females occurred in the body regions of lower leg and ankle, hip, and foot and toes (20.5, 18.6, and 11.5 injuries per 1,000 female Marines at MCT, respectively). Please note that there were fewer females than males at MCT, therefore, the proportion of injuries is more sensitive to changes for females than males.

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Source: EpiData Center (2019).

Table 2. Injury Counts and Proportions of Active Duty Marine Corps Service Members Assigned to Marine Combat Training (MCT), by Gender, January 2016 to November 2018 (n=46,016 Males, n=6,773 Females)

	Male		Female	
Body Region	**Number of Injuries**	**Injury Proportion per 1,000**	**Number of Injuries**	**Injury Proportion per 1,000**
Abdomen	5	0.1	1	0.1
Ankle and foot	9	0.2	1	0.1
Buttock	0	0	1	0.1
Cervical VCI	4	0.1	0	0
Chest (thorax)	43	0.9	6	0.9
External genitalia	2	0	0	0
Eye	38	0.8	9	1.3
Face	42	0.9	3	0.4
Foot and toes	250	5.4	78	11.5
Forearm and elbow	45	1.0	16	2.4
Hip	63	1.4	126	18.6
Knee	107	2.3	32	4.7
Lower back and pelvis	23	0.5	6	0.9
Lower leg and ankle	374	8.1	139	20.5
Lumbar VCI	11	0.2	3	0.4
Neck	8	0.2	5	0.7
Other head	69	1.5	17	2.5
Pelvic girdle	4	0.1	26	3.8
Sacral/coccygeal SCI	0	0	2	0.3
Shoulder and upper arm	123	2.7	39	5.8
Systemwide	77	1.7	34	5.0
Traumatic brain injury	29	0.6	13	1.9
Unspecified	18	0.4	11	1.6
Upper leg and thigh	56	1.2	25	3.7
Wrist, hand, and fingers	166	3.6	38	5.6
Total	**1,566**		**631**	

Data Source: Standard Inpatient Data Record (SIDR), Comprehensive Ambulatory Professional Encounter Record (CAPER)
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center on 26 February 2019.

Source: EpiData Center (2019).

USMC School of Infantry Injuries, January 2016-November 2018
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Table 3 shows that the highest proportion of injuries for males occurred in the body regions of lower leg and ankle, wrist, hand, and fingers, and foot and toes (8.8, 4.7, and 4.5 injuries per 1,000 male Marines at MCT, respectively), while the highest proportion of injuries for females occurred in the body regions of lower leg and ankle, shoulder and upper arm, and systemwide (58.8, 29.4, and 29.4 injuries per 1,000 female Marines at MCT, respectively). Please note that only 68 females attended ITB between January 2016 and November 2018, so the proportion of injuries is very sensitive to changes; there were no more than four reported injuries to any body region for females at ITB.

Table 3. Injury Counts of Active Duty Marine Corps Service Members Assigned to Infantry Training Battalion (ITB), by Gender, January 2016 to November 2018 (n=21,635 Males, n=68 Females)

	Male		Female	
Body Region	**Number of Injuries**	**Injury Proportion per 1,000**	**Number of Injuries**	**Injury Proportion per 1,000**
Abdomen	14	0.3	0	0.0
Buttock	1	0	0	0.0
Cervical SCI	7	0.2	0	0.0
Cervical VCI	3	0.1	0	0.0
Chest (thorax)	29	0.6	0	0.0
External genitalia	6	0.1	0	0.0
Eye	51	1.1	0	0.0
Face	61	1.3	0	0.0
Foot and toes	209	4.5	0	0.0
Forearm and elbow	58	1.3	0	0.0
Hip	71	1.5	1	14.7
Knee	137	3.0	1	14.7
Lower back and pelvis	33	0.7	0	0.0
Lower leg and ankle	404	8.8	4	58.8
Lumbar VCI	14	0.3	0	0.0
Neck	6	0.1	0	0.0
Other head	106	2.3	0	0.0
Other, multiple, and unspecified	1	0	0	0.0
Pelvic girdle	17	0.4	0	0.0
Shoulder and upper arm	128	2.8	2	29.4
Systemwide	115	0.0	2	29.4
Thoracic or dorsal VCI	5	0.1	0	0.0
Traumatic brain injury	27	0.6	0	0.0
Unspecified	22	0.5	0	0.0
Upper leg and thigh	55	1.2	1	14.7
Wrist, hand, and fingers	218	4.7	1	14.7
Total	**1,798**		**12**	

Data Source: Standard Inpatient Data Record (SIDR), Comprehensive Ambulatory Professional Encounter Record (CAPER)
Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center on 26 February 2019.

Source: EpiData Center (2019).

Discussion

Lower leg and ankle injuries were the highest proportion of body region injuries for all MCT and ITB school locations between January 2016 and November 2018, with the exception of ITB West training school. At this location, hand and fingers injuries were the highest proportion of injuries by body region. Among injury type, sprains and strains had the highest proportion of injuries for both MCT and ITB between January 2016 and November 2018.

Overall, females had higher proportions of acute injuries for both MCT and ITB compared to males. There are many possible factors that could contribute to this trend. For example, MCT and ITB have less females than males attend, so the proportion may be more sensitive to small changes in the total number of acute injury cases. Additionally, females may be more prone to certain types of acute injuries than males, due to reasons such as training practices and anatomical differences. Furthermore, females may be more likely than males to seek medical treatment for acute injuries due to social and cultural factors. However, further investigation would be necessary to determine the drivers of this trend.

Limitations

Incident injuries, IDM "cells" of unique combinations of the body region and nature of injury, or injury type, categories (e.g. knee + burns, knee + fracture, systemwide + poisoning), are presented in this report. However, medical encounter data was only obtained for the time period the SM was in SOI.

The injury proportions presented in this report reflect acute injuries only and do not include injuries due to chronic microtrauma, i.e. "overuse" injuries, such as stress fractures and tendonitis. The injury analyses included in this report are based on medical encounter data rather than unit mishap report data, and do not include injuries which did not receive medical care. Purchased care visits, or visits outside the fixed MTFs were also not included in this analysis.

Medical encounter data used in this analysis were routinely generated within the Composite Health Care System at fixed MTFs; data from MTFs using the MHS Genesis system (Pacific Northwest locations) were not available for this analysis. This encounter data consists of ambulatory clinical encounters and inpatient discharges and does not include records from shipboard facilities, some battalion aid stations, or in-theater facilities. Outpatient encounter records have a maximum of ten diagnosis codes, while inpatient records have a maximum of twenty diagnosis codes.

Diagnoses in medical encounters depend on correct ICD-10-CM coding practices. Data for medical surveillance are considered provisional, and medical case counts may change if the record is updated after the report is generated. Additionally, because records are submitted into the

Source: EpiData Center (2019).

system at different times, there may be patients who had an inpatient or outpatient encounter but were not captured in the current data.

DMDC provides monthly snapshots of each active duty, reserve component, and deployed Marine Corps SM's personnel record. Data are provided to DMDC by the service, and analyses are dependent on the quality and completeness of these data. Any changes in a service member's status after the monthly data were extracted would not be captured until the following month.

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Source: EpiData Center (2019).

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